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ORIGINAL MEMOIRS.

AN OPERATION FOR THE RADICAL CURE OF ANEURISM BASED UPON ARTERIORRHAPHY.

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I.

THE radical cure of aneurism as classically described embraces two distinct procedures: (1) The old operation of Antyllus, in which the sac is left *in situ* after evacuation of the contained clot and ligation of the proximal and distal ends of the main artery outside of the sac, and (2) Purmann's operation, also attributed to Phillagrius, in which the sac is extirpated *in toto* or in its greater part. Numerous modifications of these procedures have been suggested at various times and by different operators, which affect details of technique, but do not alter the fundamental principles of these methods. In the original procedures, as well as in their subsequent modifications, from remote antiquity to the present time, the ligature has been relied upon almost exclusively as the hæmostatic agent to arrest the circulation in the sac and to control the bleeding from the artery which feeds the aneurism.

In the operation described in this paper, the sac is, as a rule, not extirpated or disturbed, except in so much as is required to evacuate its contents and freely expose its interior, and in this way it may be regarded as a derivative of the old

Antyllian operation. Apart from this it differs essentially from either of the classical procedures in the fact that no ligatures are applied to the main artery, and that the circulation in the sac is arrested, and hæmostasis is secured, solely by suturing the arterial orifices found in the interior of the sac. Again, in suitable cases—that is, in the true sacciform aneurisms with a single orifice of communication with the parent artery—this method will allow the operator to obliterate the aneurism without obstructing the lumen of the artery or interfering with the circulation in the injured or diseased vessel,—a great desideratum which should never be lost sight of when operating upon this class of cases.

Finally, it differs essentially from the Antyllian operation in the fact that the cavity of the sac is not simply packed or drained and left to heal by granulation, but is at once obliterated by inverting or infolding the walls of the sac with the attached overlying skin. The flaps thus formed are sutured to the bottom of the cavity, so that no dead spaces are left to suppurate or favor secondary complications.

The operation now proposed by the writer is applicable to all aneurisms in which there is a distinct sac, and in which the cardiac end of the main artery can be provisionally controlled. It is especially applicable to all forms of peripheral aneurisms of the larger arterial trunks (carotid, axillary, brachial, iliac, femoral, and popliteal); and, while the author has had no experience with similar lesions of the large visceral trunks, the principle suggested would appear to be applicable to abdominal aortic and other accessible forms of abdominal aneurisms. It is particularly indicated in the treatment of traumatic aneurisms in which the wounded artery communicates with a well-developed and circumscribed sac, and in all fusiform and sacculated aneurisms, whether traumatic or idiopathic, in which the conditions for securing provisional hæmostasis can be obtained. The method proposed does not contemplate the treatment of arteriovenous aneurism and the circumscribed or diffuse pulsating hæmatomas of recent origin, which result from arterial and arteriovenous injuries. These cases offer admirable oppor-

tunities for the conservative application of arteriorrhaphy, with the view of preserving the lumen of the injured vessel, and thus maintaining their functional value as blood-carriers. Notable illustrations of the value of arterial and venous suture in cases of diffuse traumatic aneurism, or, rather, pulsating hæmatoma, are the cases of simultaneous injury of the common femoral artery and vein, reported by Murphy,¹ of Chicago, in 1897, and by Cammaggio² in 1898. Murphy's case is especially notable as the first on record in which an artery was successfully united by suture after circular resection of the injured area. The reported cases of fully established arteriovenous aneurisms treated by separate suture of the openings of the arteries and veins are few, thus far; but those reported by Zoege von Manteuffel³ (1895), Gerard Marchant⁴ (1898), and Peugniez, of Amiens⁵ (1900), are examples of the growing appreciation of arterial suture in the treatment of this class of aneurismal injuries.* In these cases, as in the more frequent simple wounds of arteries, the technique adopted is that of angiorrhaphy, or the suture of comparatively normal arteries, and is subject to the rules which govern the application of this procedure. The anatomical and operative conditions, however,

* Including the above-cited cases of arteriovenous injury, the author has collected thirty cases of suture of the arteries alone in which the vessel had been sutured by either lateral or circular arteriorrhaphy in the human subject. One of the cases included in this compilation occurred in the author's practice while this paper was being revised for the press (November 7, 1902). The axillary artery was injured while extirpating an adherent lymphosarcoma from a woman aged fifty-eight years. The rent in the artery was closed with four lateral silk sutures which did not penetrate the lumen of the artery. The vessel was considerably reduced in caliber at the seat of suture, and the pulsation was faint at the wrist, but in a few minutes it improved, and finally regained its normal fulness. The circulation of the arm was unimpaired and the wound healed *per primam*; hæmostasis was perfect.

The reader interested in the bibliography of arteriorrhaphy and in the collective reports of cases will find valuable information in the following recent contributions: G. Tomaselli, *La Clinica Chirurgica*, Milano, June 30, 1902, Anno x., No. 6; Hubbard, *Boston Medical and Surgical Journal*, March 27, 1902; W. Korte, *Archiv für klinische Chirurgie*, 1902, Band lxvi, pp. 919-937; Salinari and Virdia, *Giornale del R. Esercito*, Roma, 1902, Nos. 4 and 5.

differ so radically from those met in the fully-developed aneurismal tumors, which are the subject of discussion in this paper, that it would be digressive and unnecessary to dwell upon them further on this occasion.

II.

The principles which underlie the technique of the author's operation are very simple, and are based upon a few well-established histological and pathological data which need be only briefly mentioned in order to grasp the rationale of the procedure and to adapt it to the variations that are met in practice. The dominant and essential feature of the operation is that the aneurismal sac is regarded as a large diverticulum or prolongation of the parent artery with which it is connected; that the lining membrane of the sac is a continuation or expansion of the endothelial intima which lines the interior of the artery, and in fact of the entire vascular system, and that the sac itself, when not disturbed from its vascular connections, is capable of exhibiting all the reparative and regenerative reactions which characterize the endothelial surfaces in general when subjected to irritation. In other words, the sac when fully formed and developed is the analogue of the serous cavities elsewhere, not only in a histological and embryological sense, but from a surgical point of view is to be treated as a serous cavity, comparable to the peritoneum, pleura, pericardium, dura, etc. In the orifices of communication which open into the sac and in the contiguous marginal areas, the identity of structure of the aneurismal sac and the parent artery is more fully confirmed and pronounced. The classical division of the sac into two types—the true and the false—which has so long obtained in pathology is simply intended to indicate the preponderance or absence of the original arterial tunics in the composition of the sac. In all cases the absence of the media, with its elastic elements, is the characteristic feature of the sac. In the fusiform aneurisms of pathological origin (so-called spontaneous or idiopathic aneurisms) the sac walls essentially represent a continuation of the pre-existing coats

of the artery, *minus* the media, which is lost and cannot be recognized beyond the margins of the aneurismal orifices; the fibrous adventitia and endothelial intima are continued as extensions of the pre-existing coats of the parent artery. In the fusiform or saccular aneurism caused by direct injury to the artery (gunshot, punctured, stab, and other wounds) the sac is in its major part an adventitious product of new formation, in which, however, the newly-formed elements resulting from connective-tissue proliferation have assumed the fibrous and endothelial characteristics of the adventitia and intima of the parent artery. It follows from all this that, whether the sac be of purely traumatic or pathological origin, it can be regarded for surgical purposes as a prolongation or expansion of the affected vessel and, as such, is amenable to the same pathological reactions which characterize the normal blood-vessels when subjected to irritation. The absence of the elastic fibres of the media, which is so significant from the pathogenic point of view, is of no consequence to the surgeon, who is chiefly concerned when performing this operation in finding tissues that are capable of displaying sufficient reactionary and regenerative qualities, so as to obliterate the sac and its orifices when brought in close contact by sutures. These necessary plastic conditions are found in the smooth inner lining tunic of the aneurism which, as previously stated, is continuous with the intima of the arteries. In the larger and older aneurisms the inner surface of the sac loses, in places, its smooth, serous surface, but the identity of the endothelial intima is lost only in the distant and peripheral parts which are not in contact with the blood current, and where fibrinous deposits cover the altered and exposed basal membrane in the form of laminated clots. But even in these cases the orifices and their marginal areas for a considerable distance beyond retain the glistening, polished appearance characteristic of the endothelial layer of the intima. As the endothelial lining of the arteries and vascular system in general is a serous membrane of mesoblastic derivation like the peritoneum, pleura, etc., it manifests the same reactionary tendencies displayed by the serosæ when sub-

jected to irritation. The reaction of the intima to irritants is very much less than that of the peritoneum, and much more than that of the dura, being about midway between the two (Murphy). It follows, again, from what has been stated, that the aneurismal sac, with its fibrous basal membrane and endothelial intima (more or less modified by morbid agencies), can be properly regarded from the surgical view-point as a serous sac closely analogous to the peritoneal serosa, and, as such, capable of yielding the same plastic results which have been so helpful to the surgeon in his interventions in the abdominal cavity.

This concept of the sac is the basis of the method here described and successfully utilized by the author in securing the obliteration of the aneurismal pouch and its orifices by suture.

The application of the suture within the sac in the manner to be described is simply an application on a larger scale of the knowledge already obtained in other fields of arterial surgery. It is simply an adaptation of the principles of arterial repair and regeneration which underlie the daily application of the modern aseptic ligature, the suture of veins and the more recently introduced but fully recognized technique of circular and linear arteriorrhaphy. The only difference between these procedures and the one now under consideration is that in the later the arterial tunics are attacked directly from within the lumen of the arteries, or, rather, inside of their expansion in the aneurismal sac; and that the sensitive intima is utilized throughout by the infolding of its surfaces, and given the best opportunity to display its plastic qualities. This is the more apparent when we consider that the aneurismal sac is not detached in this procedure from any of its surroundings, and in this way its vascular supply and its vitality are not in the least impaired.

After this preliminary statement of the general histological and anatomical data upon which the operation is based, we are prepared to consider the method itself as applied in the most typical cases.

III.

STEPS OF THE OPERATION AS APPLIED TO PERIPHERAL ANEURISMS OF THE LARGER ARTERIES.

1. *Prophylactic Hæmostasis*.—The circulation of the limb should be controlled by preliminary elevation of the limb, followed by the application of the Esmarch elastic constrictor. Prophylactic hæmostasis may also be obtained when the aneurism is situated high up near the root of a limb (or in the neck) by exposing the main artery near the cardiac pole of the tumor and compressing it with a traction loop passed under the artery and held by an assistant. Pressure may also be applied over the exposed artery by the finger of an assistant after duly protecting the vessel with a pad of sterile gauze. The artery may be still better controlled by direct pressure with padded forceps: Billroth's forceps, with broad blades and graduated catch, the blades covered with rubber (Murphy, Burci); with a special clamp for this purpose (Crile's, Allegiani's, J. Tilden Brown); by ordinary spring clamps, such as Langenbeck's Serre-Plat's (Tomaselli), etc. I have found the simple silk traction loop to be the most convenient, because it is always at hand; but I believe that a properly-made clamp, permitting a careful adjustment of pressure, such as the Crile * or Allegiani † compressors, would be preferable. In carotid and other cervical aneurisms the collateral circulation is so free on the distal side that both poles of the tumor should be controlled, if possible, before opening it.

2. *Incision of the Skin and Exposure of the Sac*.—After all perceptible pulsation in the tumor has been arrested by the measures previously described, a free incision, parallel with the long axis of the aneurism, should be made down to the sac, exposing it to view from one end to the other. When the tumor is deeply seated under the skin, the sac should be exposed

* See Problems Relating to Surgical Operations. A New Method of Controlling Hæmorrhage in Certain Operations on the Head and Neck. By George W. Crile. J. B. Lippincott Co., 1901.

† See Umberto Allegiani, Il Policlinico, Roma, Anno 8, May 10, 1902.

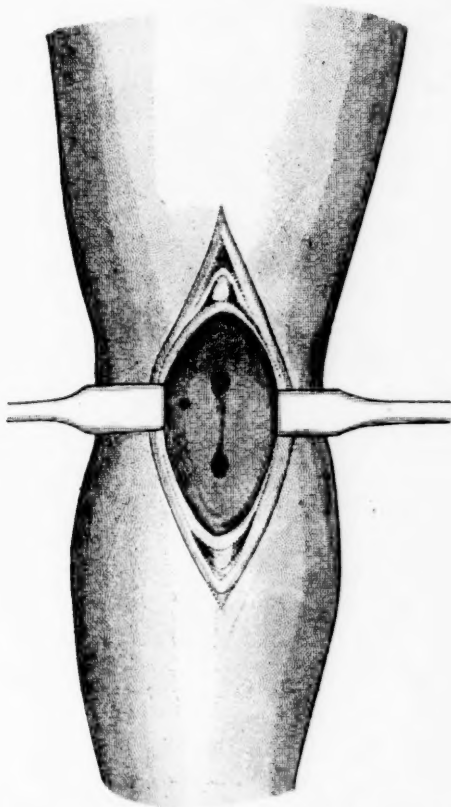
by careful dissection for some distance on each side of the cutaneous incision in order to identify any important structures (nerves, arteries, and veins) that might be adherent to its superficial surface. In any event this dissection should not be carried beyond the more prominent or superficial portion of the sac. If any important nerves or other structures should be found attached to the sac and in the way of a free longitudinal incision, these should be carefully detached and held out of the way with retractors.

3. *Opening of the Sac and Evacuation of its Contents; Recognition of the Type of Sac, Number of Openings, etc.*—A free incision is now made into the sac, extending from one extremity of the tumor to the other in its longest diameter and in the line of the main artery. The contained blood and clots are evacuated and the interior of the cavity is freely exposed to view by vigorous retraction of its edges. This will expose all the orifices which open into the sac. The type of sac that is being dealt with will now be disclosed. If it is a *fusiform* aneurism, two large openings will be seen, usually at the bottom of the sac, separated by an intervening space of variable length, frequently marked by a shallow groove which represents the continuation of the floor of the parent artery. This is more often seen in the aneurisms of the extremities than elsewhere. If the aneurism is of the *sacciform* type, there will be a single opening of variable size, circular or ovoidal in shape, which connects the sac with the main artery. The differentiation of the sac into the two fundamental varieties just described is most important in its bearings upon the further aims of the technique. In the spontaneous aneurisms of the *fusiform* type the artery blends so completely with the sac walls that its continuity cannot usually be restored, at least in the present state of our experience. In these cases the object of the suture is simply to seal the openings leading to the artery for the purpose of hæmostasis and obliteration of the sac. In the *sacciform* aneurisms, with a single opening leading to the main vessel, it is often quite possible to close the opening without encroaching upon the lumen of the parent vessel, thus

maintaining the functional as well as anatomical continuity of the artery.

We shall now consider separately the treatment of the first variety,—the *fusiform* aneurisms with two main openings.

FIG. 1.

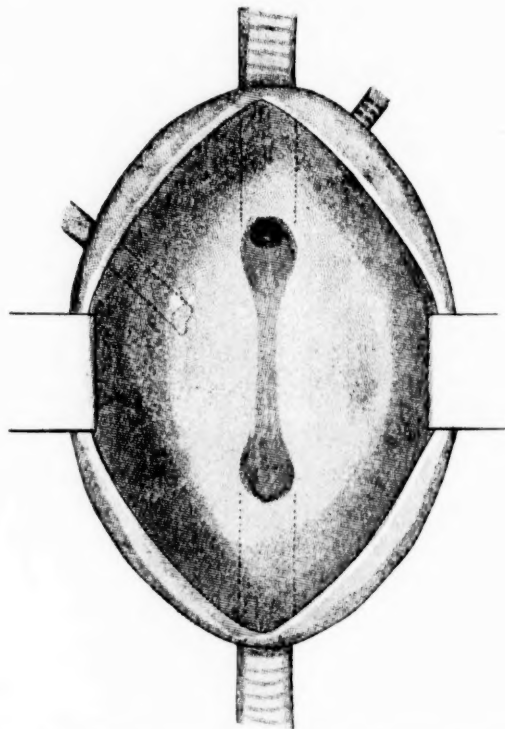


Aneurismal sac, fusiform type, with two orifices, as seen *in situ*, in the popliteal space. After controlling the circulation with the elastic constrictor the sac is exposed by dissection without disturbing it from its bed. A longitudinal incision is made from one pole of the tumor to the other. The edges are retracted, the clot removed, and the bottom of the cavity is exposed, irrigated, and made ready for the suture of the orifices seen in floor of the sac. The smaller opening of one collateral is shown on the left side.

At this juncture, while the interior of the cavity is exposed and after the chief openings have been identified, careful search should be made in the floor of the sac (especially in the fusiform aneurisms) to discover the openings of any col-

laterals or branches springing from the sac, which, if not carefully sutured, would give rise to troublesome hæmorrhage. Three of the cases operated upon by the author showed this peculiarity. If there is any bleeding from the orifices as a

FIG. 2.



Interior of large aneurysmal sac of the fusiform type exposed by retraction. The two openings lead respectively to the parent trunk on the proximal (cardiac) and peripheral sides, and the groove between them represents the continuity of the arterial walls blending with the aneurysmal sac. This was the type of sac observed in Cases 1, 2, and 4, reported in the text. The orifice of one collateral or branch originating in the sac is shown, and a large collateral opening into the main trunk near the orifice of communication, on the cardiac side, is indicated by the dotted line.

result of a free collateral supply, the closure of these openings by suture should be at once proceeded with. This kind of bleeding can only occur during the operation in cases in which the circulation of the sac is controlled solely by pressure on the cardiac side of the main artery, with a traction loop or

other contrivance, and not by general circular constriction at the root of the limb. Whenever the tourniquet or constrictor can be used the ischæmia is complete. The mechanism by which these bleedings are produced in spite of the most perfect control of the artery on the cardiac side is plainly shown in Figs. 1, 2, and 3, and especially in Fig. 17, which is intended to explain the unusual condition encountered in Observation 1. In this case, as well as in Observation 4, the most important bleeding appeared to come from the collaterals which emptied into the main artery between the point of compression and the orifices within the sac. Fortunately, this bleeding is readily controlled by pressure, which should be applied directly over the bleeding openings with the finger or sterile sponges until they are sealed by rapid, continued suture. When the hæmostasis is complete the interior of the sac should be gently, but thoroughly, scrubbed with gauze soaked in sterile saline solution, with the view to clearing it of adherent laminated blood-clots, which interfere with the healing of the sutured surfaces. This toilet of the sac also improves the circulation of the intima and prepares it for prompt plastic reaction when the surfaces of the sac are brought in apposition. In this respect the serous lining of the aneurismal sac, which is simply an extension of the intima of the parent artery, closely resembles the peritoneal serosa, and this, as is well known, unites more quickly when sutured after a preliminary irritation by rubbing, scarification, or abrasion.

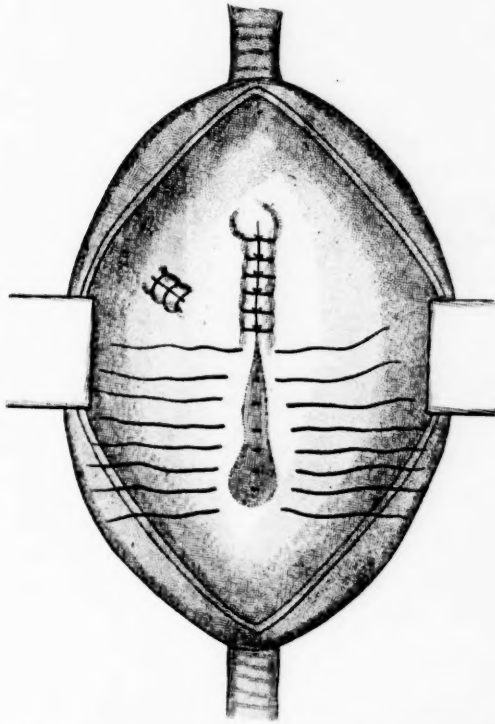
4. *Closure of the Aneurismal Orifices in the Fusiform Type of Sac.*—After the interior of the aneurism has been carefully prepared by this preliminary toilet the systematic closure of all the visible orifices opening into the sac by suture should be proceeded with, if this has not been done already, as in the conditions previously referred to. The tissues about the margin of these orifices are usually strong, firm, resisting, and hold the sutures well.

The orifices in the sac attached to the parent vessel are often large enough to admit the index-finger of the operator, and the margins are so thick that comparatively few sutures

will be required to bring them into apposition. The suture material may be either twisted, braided, or floss silk, chromicized catgut, or even the finest kind of kangaroo tendon; the size of the thread of whatever kind used should correspond with the size of the needle, and this in turn should vary in size according to the dimensions of the openings to be closed and the density of tissues to be sutured. I prefer absorbable sutures, and of these well-prepared chromicized catgut (Nos. 1, 2, and 3) is the best. This material is strong, and remains in the tissues long enough to accomplish its purpose. In applying the sutures the size and shape of the needle are important. The best needles are the round, full curved, with long eyes and prismatic points. Those designed for intestinal sutures are admirably adapted for the present purpose. The full curved needles, known as Mayo's, Kelly's, and Ferguson's, which are intended for intestinal work, are all excellent; but I have used the ordinary curved surgical needles, and even Hagedorn needles, with satisfactory results. As a rule, the continued suture will do well in all cases, especially when time is pressing. When the object of the suture is solely to seal the opening for hæmostatic purposes, and not to restore the caliber of the vessel to which it is attached, as is the case in saccular aneurisms, then the continued suture will be found to be not only the most rapid but the most effective. The distance which should separate the suture points should be regulated by the size of the opening to be closed. Eight or ten sutures to the inch are more than sufficient. In suturing wounds of *normal* arteries very fine needles and silk should be used, and the sutures should enter the vessel one-sixteenth of one-twentieth of an inch apart. In closing the orifices of aneurismal sacs the conditions are, however, altogether different, as aneurismal tissues are so much thicker and more easily approximated. What is more important is to secure a firm grip of the sac tunics so as to bring a broad surface in confrontation. In dealing with the larger openings in this class of aneurisms (fusiform), the needle should penetrate at least one-quarter or one-sixth of an inch beyond the margin of the orifice, and

then, after reappearing at the margin, dip again into the floor of the artery, and continue to the opposite margin as in the start (Fig. 3). This mode of occluding the orifice of the main artery will secure a very complete apposition of a large marginal area, including the floor of the artery which is visible

FIG. 3.



Shows the orifices in the aneurismal sac in process of obliteration by suture. The first plane of sutures may be made with fine silk, but chromicized catgut is preferred. The sutures are applied very much like Lembert's sutures in intestinal work; the first plane of sutures should be sufficient to secure complete hæmostasis.

The orifice of the collateral vessel on the left upper side of the sac is shown closed by three continuous sutures.

under the orifice. When the openings must be closed quickly, as in cases in which there is considerable bleeding from collateral vessels, the dip of the needle into the floor of the vessel may be omitted, and the margins of the orifices are brought together quickly with a continued suture. In suturing these

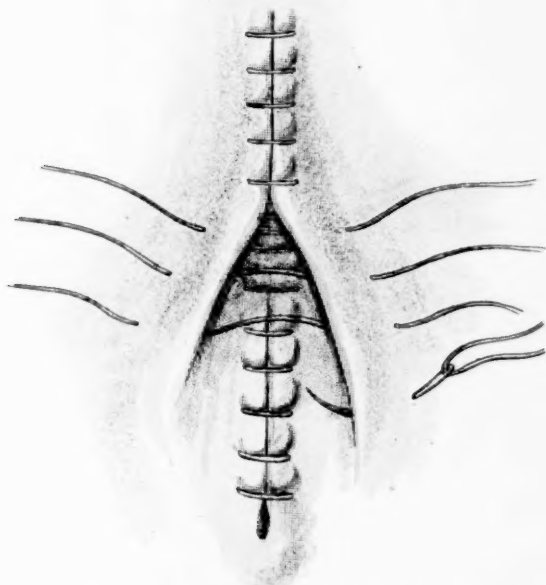
orifices the operator should act precisely as in closing perforations of the bowel covered with peritoneum, and remember that the principle of the suture is here, intima to intima or serosa to serosa, as in applying the Lembert suture to a perforated bowel. The one capital point of difference in the analogy is that the membrane dealt with is practically all serosa and that it is continuous with the interior of the artery to be closed; there is no mucosa or infection to be dreaded. Hence the invariable tendency of the tissues to heal by primary union and aseptic plastic endarteritis when brought together in broad and firm apposition.

Continuing with the technique of suture as applied to the *fusiform* aneurisms with two openings, I have found it advantageous to extend the first line of suture from one orifice to another when the intervening space is not too long. These sutures include the floor of the sac (Fig. 3), and are applied on the Lembert plan. They fold up and bring together a considerable area of the floor of the sac, which is thus raised to the upper level of the orifices; in this way they diminish not only the transverse diameter of the sac, but lay the foundation for the obliteration of the cavity which is to follow. If the floor is dense, rigid, or bound down by adhesions to unyielding parts (which is not often the case) the suture should be limited to the orifices. The subsequent steps in the technique will be considered further on in the text.

5. *The Sacciform Aneurisms with a Single Orifice of Communication; Hæmostatic and Reconstructive Suture with the View of Preserving the Lumen of the Parent Artery* (Figs. 8 and 9).—This type of sac is the most favorable for the display of the conservative value of arteriorrhaphy from every point of view. The intrasaccular suture of the orifice not only permits of the radical cure of the aneurism by closing its nutrient orifice, but also favors the restoration of the affected artery to its functional and anatomical integrity. The suture is here not only occlusive but reconstructive. The same material and needles should be used as in the previous case, the main point to bear in mind is that in introducing the sutures

these should be inserted at a sufficient distance from the usually thick and smooth margins of the opening in order to secure a firm and deep hold of the fibrous basal membrane (Figs. 10, 11, and 12). The needle should be made to appear just within

FIG. 4.



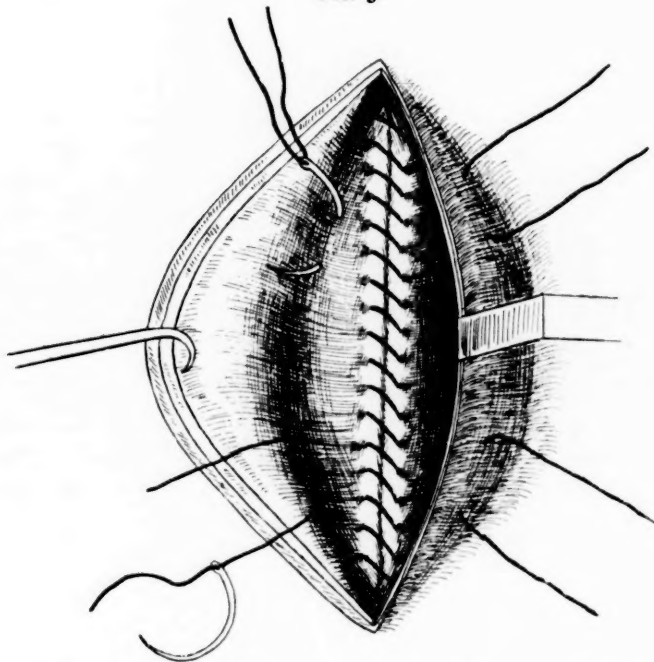
This shows a second row of sutures,—a technical detail of the operation which is advantageous, but not necessary in every case.

The first row of sutures has been completed and the arterial orifices have been obliterated. As the walls of the sac are usually relaxed, it is easy to insert a second series of sutures which add security to the first row, and, in addition, reduce the size of the cavity which is to be obliterated by inversion of the skin and surplus sac walls at a later stage in the operation. This second row of sutures is applied as in the first series, by either the continuous or interrupted method, with a curved needle, and Nos. 1, 2, or 3 chromic catgut. A large surface of the sac is thus brought in apposition, and the best opportunity given for adhesion by plastic or exudative endo-arteritis. If the floor of the sac is rigid or too adherent to the underlying parts, this second row may be omitted, and the operation can be advanced to the last step,—*i.e.*, obliteration of the sac after suture of the orifices.

the lower edge of the margin, care being taken that when the sutures are tightened the caliber of the artery will not be encroached upon so as to obstruct its lumen, and that the threads will not be brought in contact with the blood in the lumen of the

artery. Greater care must be exercised in securing accurate coaptation in this class of cases than in the fusiform type previously described. As shown in Figs. 10 and 11, it will be advantageous to begin the line of suture at some distance from the orifice, as this will secure a broader and stronger line of approximation. The larger the caliber of the parent vessel the more

FIG. 5.



Shows the details of the method of obliteration after the floor of the sac has been raised by the second row of sutures. Two deep supporting and obliterating sutures of chromic catgut are inserted through the floor of the sac on each side. The number of these sutures will vary according to the size and length of the sac that is being treated. In the smaller aneurisms, one of the deep sutures on each side will suffice; in others, two or more on each side may be required to keep the surfaces in close contact. After the sutures are passed through the floor of the sac the free ends of the threads are carried through the entire thickness of the flap by transfixion.

The plate shows the mode of placing these sutures on the left side preparatory to transfixion of the flap. The two sutures on the right side have been carried through a flap and are in position.

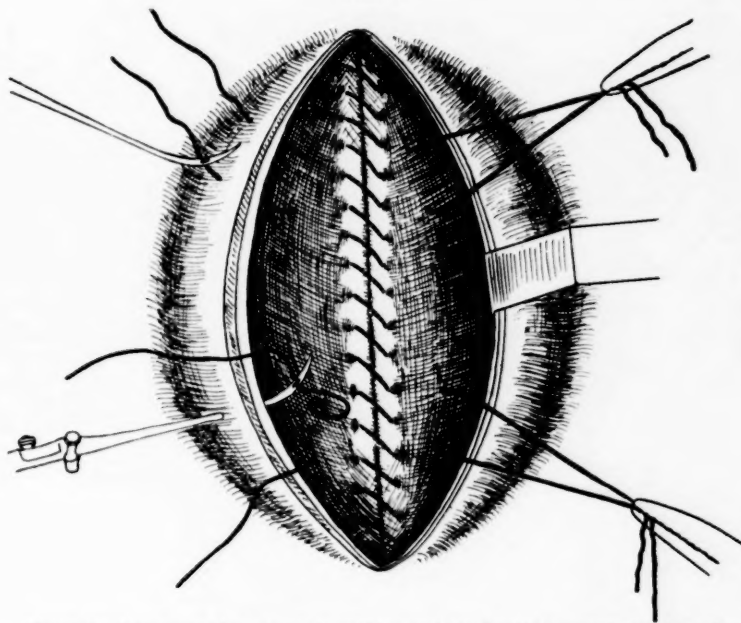
favorable will the conditions be for the restoration of the lumen of the artery and for the functional success of the operation.

6. *Removal of Constrictor and Test of Sutures.*—After all visible orifices in the sac have been closed by suture, the

constrictor or other provisional means adopted to control the circulation are removed. The interior of the cavity should now be perfectly dry, and the only change noticed by a return of the circulation should be an improved, more pinkish color of the sac. If there be any oozing capillary points these will be usually stopped by pressure and by the means subsequently adopted to obliterate the cavity.

7. *Obliteration of the Aneurismal Sac* (Figs. 4, 5, 6, and 7).—This step of the operation is the same in all cases. In

FIG. 6.

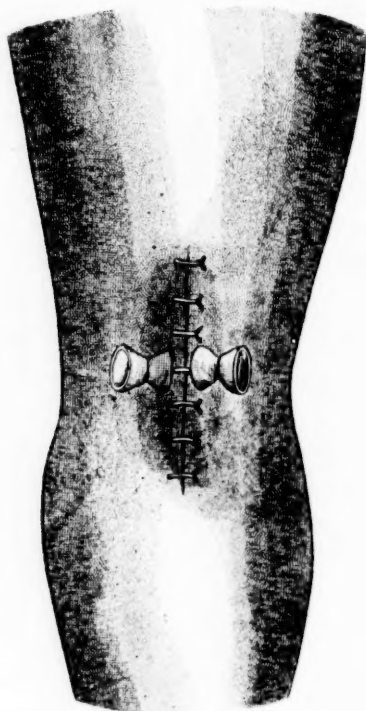


Shows the deep supporting sutures in position and the details of transfixion of the flaps. The Reverdin needle is used to carry the free ends of the threads through the flaps formed by the skin and aneurismal walls.

large sacs, where the floor of the cavity is deeply situated and there is an abundance or even redundancy of material, it will be a good practice, as previously stated, to reinforce the first line of occlusive sutures by a second row, applied also on the Lembert plan at a higher level. This second row will raise up and bring together a considerable surface of the sac floor and lateral walls of the cavity, and when finished will not only bury

the first plane of sutures, but will reduce the dimensions of the sac considerably (Fig. 4). The closure of the aneurismal space is now readily accomplished by turning the relaxed flaps of skin into the interior of the cavity. If the sac has not been previously dissected from its surroundings, the skin flaps will

FIG. 7.

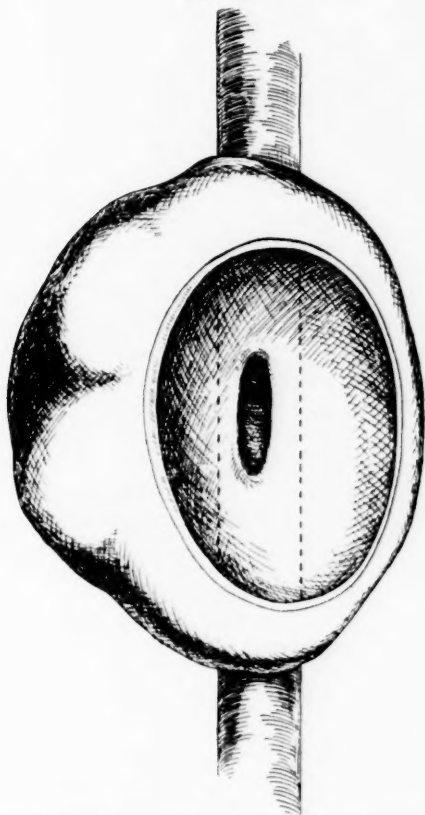


Shows the operation completed. In this figure only two supporting sutures are shown on each side instead of the four shown in the other figures. The skin and sac walls form two lateral flaps on each side of the incision, and readily fall to the bottom of the sac, thus lining and obliterating the entire cavity. A series of interrupted absorbable sutures are now placed so as to bring the edges of the skin in contact, several of these including the floor of the sac in their bight (as shown in cross section, diagram No. 13), so as to close the space entirely in the middle line. The two lateral supporting sutures are tied firmly over small pads or rolls of sterile gauze, thus bringing all the interior of the sac in apposition.

be lined on their inner surface with the smooth sac walls, thus constituting an aneurismo-cutaneous flap on each side. These flaps, in their relaxed state, can, as a rule, be made to touch the bottom of the cavity with comparative ease. One or two

relaxation sutures on each side of the median line will usually suffice to tack down and hold the skin flaps in contact with the bottom and sides of the sac. The sutures are best applied with a large size, full-curved intestinal needle, which is made to grasp a considerable portion of the sac wall in its bight. The

FIG. 8.



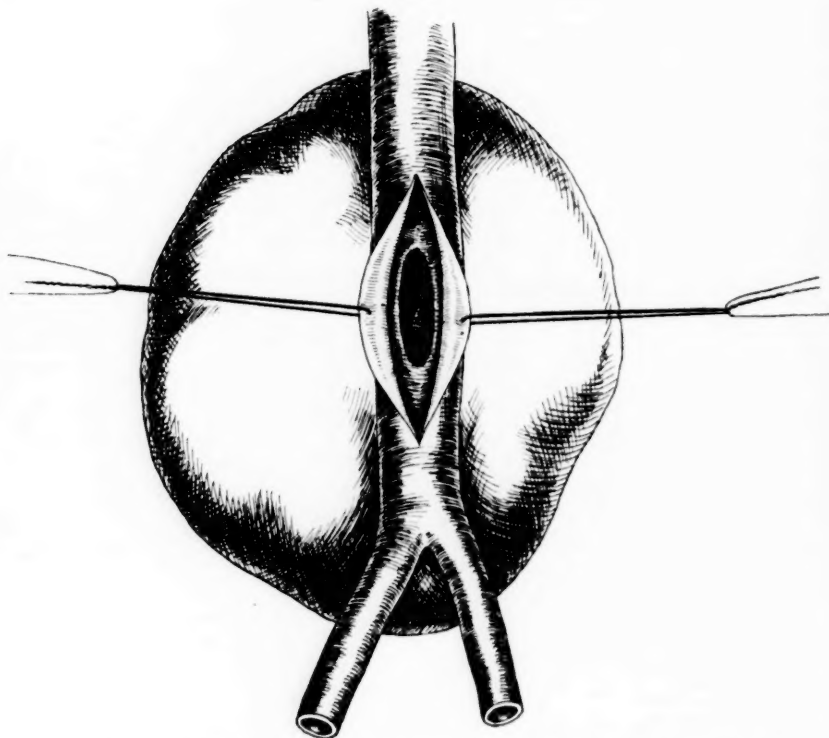
This shows a typical *sacciform* aneurism with one main orifice of communication opening into the sac. In this type of aneurism the lumen of the parent artery is maintained. It is possible in this class of cases to close the orifice of communication by suture without obliterating the lumen of the artery, and without interfering with the circulation in the main artery or of the distal parts supplied by it.

needle should penetrate through the entire thickness of the sac; by carrying it through in this way a loop is formed, the two ends of which are carried through the skin flaps by transfixion with a straight Reverdin needle, and tied firmly over a loose

pad of gauze after the flaps have been carefully adjusted in position (Figs. 5, 6, and 7).

The principle adopted in the obliteration of the sac has been made familiar by Neuber's method of closing bone cavities

FIG. 9.

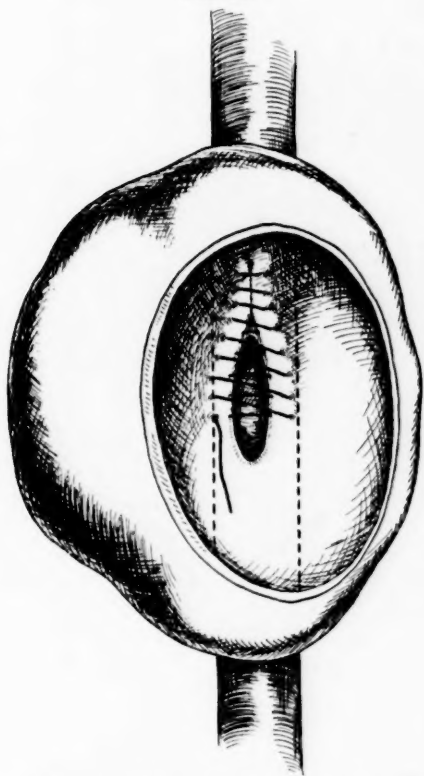


This figure is simply intended to show the same type of sacciform aneurism, viewed from the posterior side. The parent artery is continuous throughout, and is simply attached to the sac at the orifice of communication. The artery has been laid open on its posterior surface, showing that the orifice of communication can be closed on the aneurismal side, without occluding the lumen of the parent artery. The drawing is taken from a pathological specimen, and is utilized solely to show the favorable anatomical characteristics of this class of aneurism for the conservative procedure suggested by the author.

with cutaneoperiosteal flaps. After the relaxation sutures have been tied the edges of the skin should come in close contact in the median line, and all that will be required to finish the operation will be a few interrupted catgut sutures to complete the approximation of the skin margins (Fig. 7). When

the operation is completed, the aneurismal cavity is obliterated without in the least disturbing the sac or interfering with its vascular relations. The collateral circulation, which is usually important in the vicinity of the aneurism, is also respected, and in this way the best condition for the maintenance of a healthy

FIG. 10.



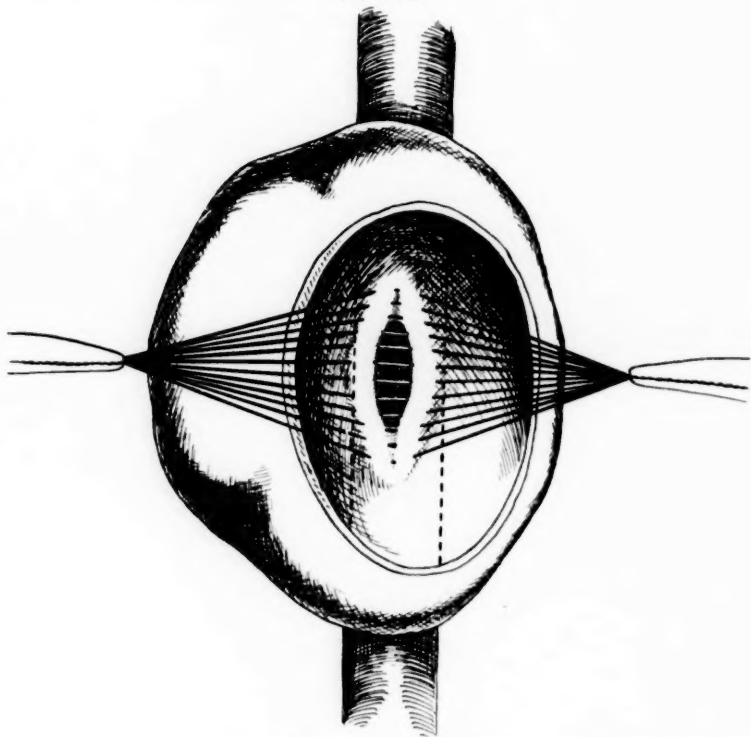
Shows the same sac opened. The dotted lines indicate the position and relations of the main artery to the sac and to the orifice of communication. The object of the operation in this case is to close the orifice of communication without obliterating the main artery. The closure of the orifice with continued suture is shown in the plate.

nutrition in the sac and in the parts beyond the aneurism are assured.

At the site where the bulging tumor previously existed there will be a depression varying in depth according to the size of the original sac, and presenting the appearance of an

inverted hollow cone or ovoid. As no exposed or raw surfaces are left in view, there is no need for drainage, and union *per primam* can be confidently expected, thus greatly abbreviating the duration of the after-treatment.

FIG. 11.

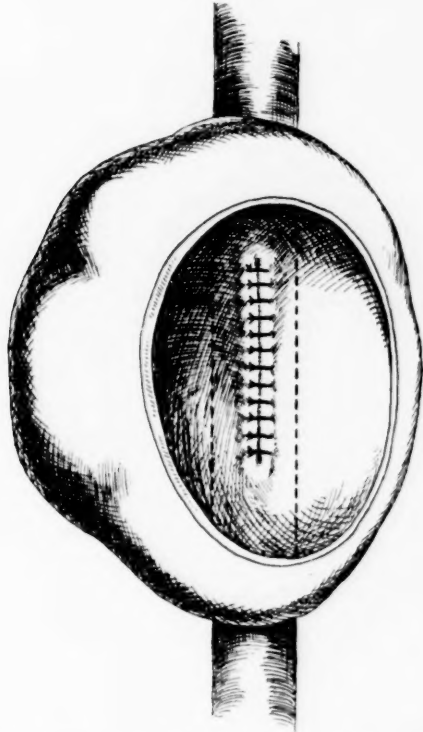


This shows the closure of the orifice of communication in the same type of sac with interrupted instead of the continued suture. Whether the continued or the interrupted suture be used (the former being preferred by the author), it is important to begin the suture line at some distance from the orifice, so as to infold a considerable surface of the sac at the start; then care must be exercised to insert the sutures so as to grasp a considerable surface of the margin, in a manner that the point of the needle shall penetrate the entire thickness of the margin, and yet not so far within the lumen of the artery as to encroach upon its caliber or to leave the suture material in contact with the blood current. When the sutures are tightened they should bring the marginal surfaces in broad apposition without projecting into the anterior portion of the artery or encroaching excessively upon the lumen of the vessel.

Dressings.—A simple sterile gauze dressing is applied as a graduated compress to fill the hollow left in the place previously occupied by the aneurism. This is held in position by a few strips of aseptic rubber plaster. The limb is then wrapped

up from the periphery to the trunk in a thick layer of cotton-batting, over which a well-padded splint is adjusted to secure the immobility of the entire limb, especially if the field of the operation occupies one of the flexures of the extremity. If suf-

FIG. 12.



Shows the obliteration of the orifice of communication completed. The appearance following the application of interrupted suture is shown in this figure. If the suture has been properly applied, the hæmostasis will be complete, and the circulation in the main artery restored. After this has been done, the second protective row of sutures shown in Fig. 4 and other details of the technique of the obliteration of the sac (shown in Figs. 5, 6, and 7) should be carried out precisely as in dealing with aneurisms of the fusiform type. Anomalous orifices or collaterals opening into the sac, in addition to the main orifices, are less liable to exist in the sacciform aneurisms than in the fusiform aneurisms, in which a large area of the arterial wall is involved. In any event, however, should such additional orifices exist, they should be individually closed by a few continued sutures, as shown in Fig. 3.

ficient padding has been applied to protect the distal parts from undue pressure or exposure to cold, a starch bandage or a light plaster-of-Paris roller over the whole limb will complete the

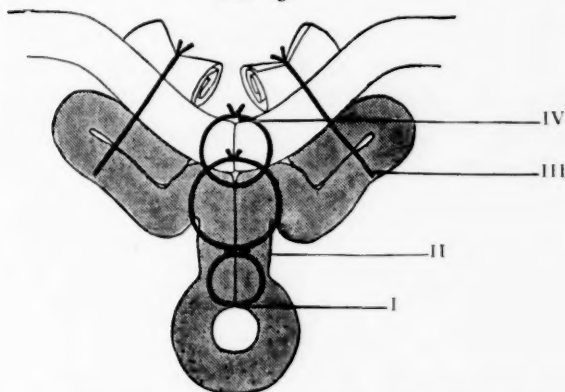
dressing. If there are no reasons to the contrary, the first dressing should not be disturbed for a period of a week or ten days.

IV.

ADDITIONAL REMARKS ON THE OBLITERATION OF THE SAC IN CERTAIN ATYPICAL AND EXCEPTIONAL CONDITIONS.

It is possible that in certain cases the obliteration of the cavity by inverting the walls of the sac with the overlying skin will not be practicable. This is more likely to be the case in the iliac and other abdominal aneurisms in which the sac is covered by peritoneum. In such a contingency the same object will be obtained by inverting the sac walls with the overlying peritoneum which covers the aneurism. The peritoneum is not to be separated by dissection, but is allowed to remain adherent to the sac, and is utilized in place of the skin flap with even greater ease and certainty of successful union than when the skin is used. The procedure is therefore precisely the same as that adopted in the typical surface cases, with the only exception that the peritoneum is used instead of the skin and that no gauze pads are used with the deep approximation sutures. Again, when operating upon deep-seated aneurisms of the extremities or neck, it may happen that in stout, well-nourished or muscular subjects, especially when the femoral or popliteal regions are involved, that the skin flaps will not stretch enough to reach the bottom of a deeply placed cavity without excessive tension. In such cases, rather than imperil the vitality of the skin by overstretching, it will be the safer plan to obliterate the sac itself with its own walls independently of the skin. The technique will then be the same as that described for the typical surface cases as far as the obliteration of the orifices is concerned, and the introduction of the second or protective row of stitches, as shown in Fig. 4; after this the excess of sac wall that remains above the second line of stitches is excised as superfluous, and the free edges of the sac are approximated by interrupted or continued catgut sutures. In this way the inner surface of the sac, including the orifices, floor, and part of the lateral walls are thoroughly approximated, and the sac is

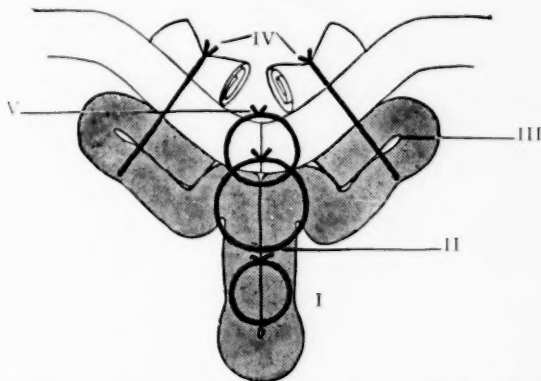
FIG. 13.



A diagram showing sectional view of the obliterated aneurismal sac when the lumen of the parent artery is preserved and the vessel originally communicates with the aneurism by a single orifice.

I, First line of sutures which close the orifice of communication and restore the lumen of the parent vessel; II, second row of protecting sutures which also reduce the size of the sac; III, supporting through-and-through sutures, which bring the roof and floor of the aneurism in contact; IV, sutures which hold the skin flap and sac in contact with the bottom of the cavity. This diagram will also show the result of the procedure illustrated in Figs. 15 and 16.

FIG. 14.



Sectional diagram showing method of obliterating the aneurismal sac in the *fusiform* type of aneurism with two openings. In this class of cases (Figs. 1, 2, and 3) the tunics of the parent artery blend with the sac, and the arterial channel cannot usually be restored.

The diagram shows the first row of sutures (I), which obliterates the orifice of the artery at the bottom of the sac. The second row of sutures is shown higher up (II), and also the effect of this row in reducing the capacity of the sac. The obliteration of the remaining part of the cavity by the folding in or inversion of the sac walls, with the attached overlying skin, is shown in III.

The function of the deep sutures (IV) tied over gauze pads, and of the more superficial skin sutures (V) in obtaining firm contact of the opposed surfaces, is also shown. This drawing is purely schematic; it gives an exaggerated idea of the size of the sac walls, and is chiefly intended to give an idea of the position of the sutures and other parts.

obliterated, but remains buried in the floor of the incision. It is easy then to close up the wound by bringing together all the soft parts by separate rows of buried sutures, including the skin incision, which is closed without drainage. It is most important to remember in all this work that the sac is dependent for its nutrition upon the vessels furnished largely by the perianeurismal tissues, and that any extensive dissection of the sac from its bed is likely to interfere with the reactionary processes so necessary for its obliteration. Therefore, it will be safer to excise those parts of the sac which have been detached by dissection from their vascular surroundings. One of the dangers of the old Antyllian operation was the tendency to suppuration and sloughing, which followed through a disregard of this precaution; the sac was often entirely lifted out of its bed, and allowed to remain in the wound after the vessels which communicated with it had been ligated. In this way it remained a foreign and dead body which taxed all the resources of nature to eliminate, and was the cause of endless trouble and even fatal disasters from infection and secondary hæmorrhage. No wonder, then, that after the advent of the aseptic period the surgeon should have discarded the old operation and turned with favor towards the radical operation with extirpation of the sac.

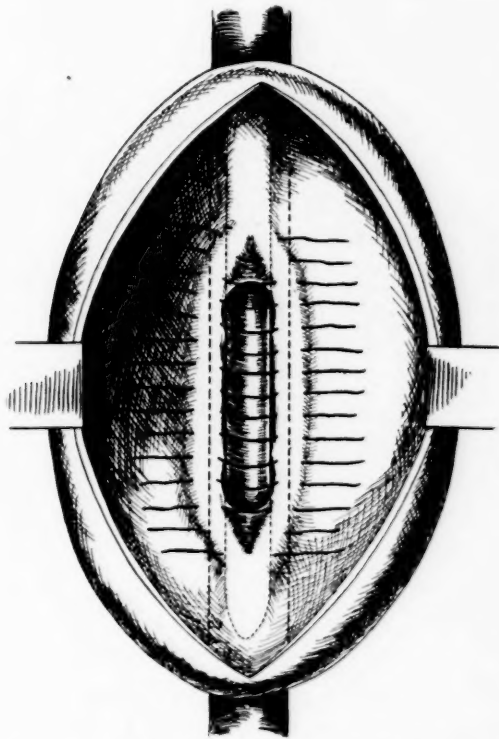
V.

SUGGESTIONS IN REGARD TO THE TECHNIQUE OF THE OPERATION IN DEALING WITH FUSIFORM ANEURISMS WITH TWO ORIFICES.

It will be noticed that in describing the various steps of the operation we have constantly kept in mind the two fundamental types of aneurisms,—the fusiform and the sacciform. The fusiform, in which the main artery communicates by two openings with the sac, is more often of pathological origin, the sacciform of traumatic causation. Both of these types, however, may be seen when aneurisms follow a direct injury of the artery, and when this is the case in the fusiform aneurisms the coats of the sac are not so diseased or degenerate as to prohibit a further conservative effort to restore the lost lumen of the

parent artery. In these fusiform sacs the practice of the author thus far has been to limit the intervention to the obliteration of the orifices where they blend with the sac and to suture them in the manner previously described. While writing this paper, the thought has suggested itself that it would not be impracticable or unreasonable when favorable

FIG. 15.

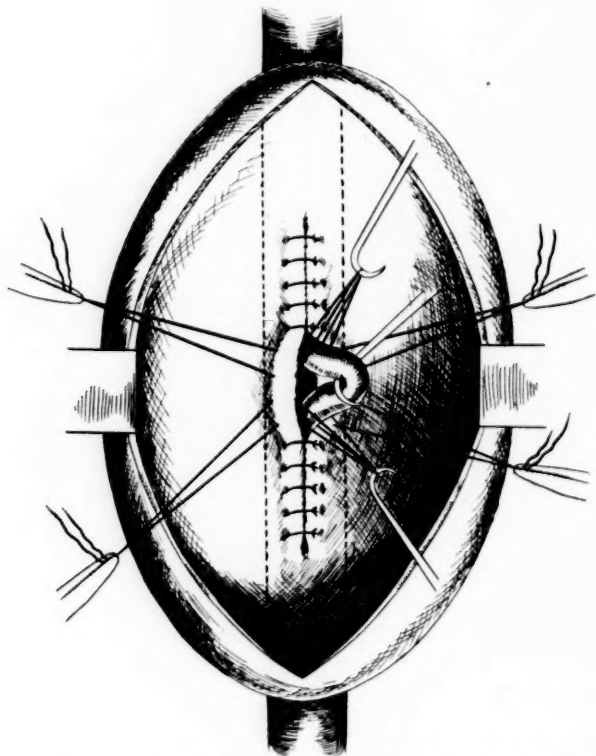


Shows a possible but not yet tried method of restoring the large lumen of the parent artery in favorable cases of fusiform aneurism with two openings in which the healthy and flexible character of the sac will permit of the restoration of the arterial channel by lifting two lateral folds of the sac and bringing them together by suture over a soft rubber guide. The principle of this operation is precisely like that adopted in a Witzel gastrostomy. The figure shows the soft rubber catheter lying on the floor of the sac and inserted in the two orifices of communication. The sutures are placed while the catheter is in position acting as a guide.

conditions presented themselves, as is apt to be in the larger aneurisms, which offer an abundance of material and a flexible floor, to go a step further and to re-establish the lost arterial

channel by the procedure shown in Figs. 15 and 16, and in sectional diagram 14. The principle of this operation is precisely that adopted in Witzel's method of gastrostomy. As shown in Fig. 15, a soft-rubber catheter or tube, corresponding in diameter to the size of the parent artery, is laid on the floor of the sac, and is inserted as a guide in the two orifices of

FIG. 16.



This shows a more advanced step of the procedure described in Fig. 15. The sutures are nearly all tied, and the new channel is completed except in the centre. The two middle sutures are hooked and pulled out of the way while still in position, and the catheter is withdrawn. The obliteration of the sac and final steps of the operation are carried out precisely as previously described in Figs. 4, 5, 6, and 7.

communication. Two lateral folds of the sac are now raised from the floor on each side of the catheter by means of two sets of sutures introduced on the Lembert plan. These ridges or folds should be raised high enough on each side of the guide

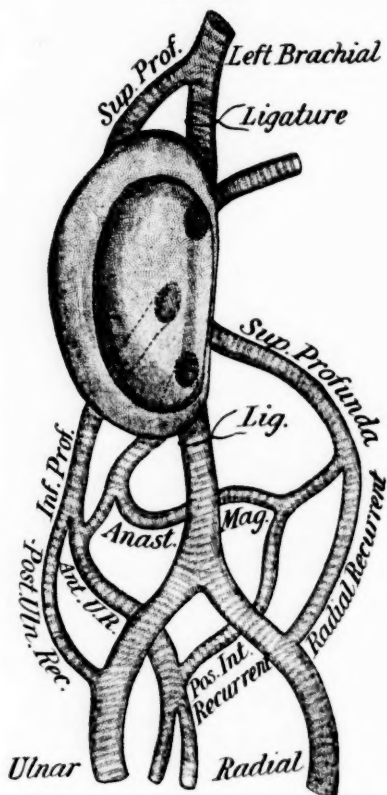
to cover it completely in the middle line. A row of sutures should now be placed in a series from one of the main orifices to the other, leaving the catheter *in situ* until all are placed. The subsequent steps of the procedure are shown in Fig. 16. The sutures are all tied except those in the centre of the line of union, which are not tied until the guide has been removed. When possible a second superimposed continued line of sutures should be applied over the first step, as is shown in Fig. 4, illustrating the typical procedure. In this way a continuous channel is established which connects the main orifices of communication and permits the blood to flow directly and uninterruptedly through the tract of the parent vessel to the distal parts. While it is evident that this suggestion is only applicable to certain favorable cases, its practicability and the great object to be gained by its accomplishment should not be overlooked, more especially in the great aneurisms at the root of limbs and in the abdomen, where the conditions justifying its performance frequently exist.

VI.

My experience with this method of endoarteriorrhaphy, or, rather, to define it more accurately, endoaneurismorrhaphy, if I may be permitted such a neologism, is limited to four cases: two of direct traumatic aneurism of the brachial, caused by gunshot wounds, one of which involved the lower and the other the upper third of this artery; one femoral and one popliteal, and both of the so-called spontaneous variety. The first operation dates as far back as March, 1888, and was published in the *Medical News* in the issue of October 27, 1888. This case presented features of exceptional interest apart from the method of treatment employed. It is one of the cases of traumatic aneurism of the brachial caused by gunshot wound. In this case (a very large sac) indirect and direct compressions by Reid's method were tried unsuccessfully; then ligatures were applied above and below the sac at different sittings, and failed: the pulsation returned on the tenth day. Upon opening the aneurism its rebelliousness was explained by finding

the openings of several large collaterals which kept up the circulation in the tumor after the main artery had been ligated above and below the sac. The anastomotic circulation which

FIG. 17.



This is a reproduction of a diagram published in the *Medical News* (Philadelphia), October 27, 1888. It is intended to explain the condition found in a case of traumatic aneurism in which the author applied intrasaccular arteriorrhaphy for the first time. The abundance of the collateral supply in that case could only be accounted for by a distribution of the vessels such as shown in this figure.

The failure of the ligatures applied to the main artery above and below the sac and difficulties of extirpation were well illustrated in this case, and led to the suture of the aneurismal orifices, which promptly secured their obliteration and an immediate arrest of the hæmorrhage.

accounted for this unusual condition is explained by Fig. 17, which is reproduced from the original article. In this case (a large aneurism of the fusiform type) extirpation was at-

tempted, but had to be abandoned because of the great risk of injuring adherent nerves which were incorporated in its walls. Under these circumstances, and without any previous knowledge of the practicability of suture in such cases, all the bleeding was immediately controlled by suturing the orifices with fine silk. A redundant portion of the sac which had been detached by dissection was excised, leaving the floor and lateral walls undisturbed, to heal by granulation. A long interval elapsed between this and the next case, which was operated by more advanced technique in the summer of 1900; several opportunities had presented themselves in the interval for the application of this method, but I had not yet overcome the dread of atheroma and secondary hæmorrhage. But the disastrous results which followed in a case of femoral aneurism treated by Hunterian ligation, in which the patient barely escaped with his life after an amputation at the thigh for gangrene, and also the vivid recollections of the great difficulties encountered in extirpating a femoral aneurism of Scarpa's triangle, followed also by gangrene of the toes, led me to revert to the method of incision and suture detailed in the previous case. After this experience I grew more confident, and applied the operation with more boldness, and added the modifications referred to in describing the technique of obliteration.

While this experience is too limited to justify any dogmatic or broad generalizations, the simplicity of the method and the favorable results thus far obtained are sufficient to encourage its more general application. The later suggestions and modifications made in this paper, which aim at the further conservation of the main trunk, and thus safeguarding the integrity of the circulation in the sacciform and fusiform aneurisms, are still waiting the test of clinical experience. But from *a priori* grounds and the experience thus far gained, it would appear quite reasonable to anticipate still greater gains in a conservative direction in a group of cases in which the classical procedure is still fraught with great uncertainty.

As the chief object of this paper has been to describe the technique of this procedure and to relate the author's personal

experience in its practical application, no systematic effort will be made to study its comparative merits in relation to other methods of treating aneurisms. The indications for the application of this operation have been sufficiently stated. It is intended to meet the conditions which call for the radical operation by extirpation. It is not intended to supplant it altogether, because extirpation is still the method of election in dealing with the smaller aneurisms of the secondary arteries of the extremities, in which the question of mortification or gangrene does not enter into consideration on account of the certainty of an abundant vascular supply. Its chief object is to simplify the technique of the radical cure, to make it less bloody, to diminish the traumatism, to interfere less with the important neighboring structures, which are often damaged by extirpation (veins, nerves, and organs), and, above all, to reduce the dangers of gangrene of the distal parts to the strictest minimum compatible with the cure of the aneurism.

It is only just to state that after a careful inquiry into the literature of aneurism I have failed to find any reference to a procedure that resembled or suggested the method described in this paper. In the constantly growing list of contributions on the subject of arterial suture there are frequent allusions and suggestions as to the possible advantages of suture in the treatment of traumatic and arteriovenous aneurisms. These recommendations all refer to the direct suture of the artery in recent wounds or at the bottom of diffuse extravasations and pulsating hæmatomas in which no well-circumscribed sac exists. The three reported cases of arteriovenous aneurism in which the arteries had been detached from the veins and sutured by lateral and circular arteriorrhaphy have been mentioned at the beginning of this paper. These cases, however, represent conditions which are entirely different from those under consideration. A single exception that I have found in the literature of the subject is the notable contribution by J. B. Murphy, of Chicago, on the resection of arteries and veins injured in continuity (*Medical Record*, New York, January 16, 1897), in which he boldly and very originally discusses the practicability

of attacking fusiform aneurisms by *extirpation* of the sac and suture of the arterial orifices. He divides the indication for arteriorrhaphy into four groups: (1) Injuries to large vessels in operations; (2) injuries of large vessels from stab, puncture, bullet, or lacerating wounds; (3) traumatic and dissecting aneurisms; (4) sacculated, fusiform, and arteriovenous aneurisms. His remarks on groups 3 and 4 are so apposite to the present subject that they justify full quotation, as they bear the stamp of authority vested by an unusually large experimental and clinical experience in arterial surgery. He says: "In traumatic aneurisms of long standing we have the best variety of cases for arterial suture. The opening in the artery is usually small, the arterial wall is healthy, and a sufficient quantity of aneurismal stump may be retained to produce a firm line of approximation. From a theoretical stand-point, as well as from the results of experiments, there is no danger of the formation of aneurism at the point of primary suture for injuries, and should not be for secondary sutures, as in aneurisms of this class. The vessel should be exposed above and below the aneurism, and temporary hæmostasis obtained by a very mild compression forceps. The aneurismal sac should then be freely opened and dissected down to the position of the opening in the artery. The edges of the artery should be freshened and closed, the same technique being observed as in primary suture. In the fourth class of cases—*i.e.*, sacculated, fusiform, and arteriovenous aneurisms—the aneurismal sac should be exposed and dissected down to the healthy coats of the artery, where it should be amputated, leaving sufficient of the aneurismal coat and arterial wall to allow a row of sutures involving one-sixteenth of an inch of the margin on either side, so that when the suture is complete the size of the vessel will be below its normal caliber. This lessens the arterial pressure of the vessel at that point, and there should follow a union of the wall," etc.

This, I believe, is the first specific statement that has been published describing a general method of dealing with aneurisms by suture, though I had used the method of suture in the

obliteration of the orifices of an aneurism, and published a full account of the case nearly ten years before the publication of Dr. Murphy's experimental contribution.

It will be seen, however, by the quotations above given that Dr. Murphy's procedure, bold and brilliant as it is in its conception, is entirely different from that described in this article. Murphy's suggested operation is practically an extirpation of the sac, and as such is fraught with all the difficulties and undesirable features of this operation, with the added difficulty of suturing the openings in the vessel itself. He has also overlooked the fact that in fusiform aneurisms the continuity of the main artery is lost for a considerable distance in the sac, where it merges completely with the aneurismal walls; hence the impracticability of resecting the sac by the method he suggests. In the sacciform and the arteriovenous aneurism his procedure is perfectly feasible, but the same result can be accomplished by the much easier and safer plan described in this contribution.

VII.

In conclusion, the writer would submit the following propositions:

1. That the recognized advantages of the radical operation for the cure of aneurisms of the peripheral arteries, as demonstrated by the statistics of the last decade, can be greatly increased, and the sphere of application of this operation can be broadened by the adoption of the method of suture and obliteration of the sac instead of the classical ligation of the arteries, with or without extirpation, as hitherto practised.
2. That the closure of the arterial orifices which supply the aneurismal sac, whether these be single or multiple, by means of suture, and within the aneurismal sac itself, greatly simplifies the technique of the radical operation, and is a reliable means of securing hæmostasis.
3. That in favorable cases—and the saccular aneurisms with a single orifice communicating with the lumen of the larger arterial trunks are the most favorable—it is possible, by careful suture, to obliterate the aneurismal opening without obstruct-

ing the lumen of the parent artery, thus protecting the limb from the risk of gangrene.

4. It is also possible in favorable cases of fusiform aneurisms of traumatic origin, and in all those in which the sac material is healthy and pliable, to restore the lost continuity of the artery by building a new channel which will connect the two main orifices of communication and restore the interrupted circulation in the parent vessel. This result can be obtained by utilizing the sac in the manner previously described by the author.

5. That the fear that atheroma and other degenerative changes will interfere with the healing and repair of the arterial tunics has been greatly exaggerated is shown by the abundant experience of the aseptic period in the ligation of sclerotic arteries in continuity, in the absence of secondary hæmorrhage in the amputated stumps of the aged, diabetic, and other arterially diseased subjects (Heidenhain, Webber, Barwell, and others), and is still demonstrated more fully by the observations and statistics of the partisans of the radical operation by extirpation (Delbet, Kubler, Ransohoff, Annandale, and others) who have reported numerous successful results in spontaneous as well as in traumatic aneurisms.

6. The fallacy and dangers of the old operation of Antyllus lie (*a*) in the fact that the preliminary ligation of the main artery above and below the sac will not always control the bleeding from the collaterals which often open into the aneurism or into the main trunks between the orifices in the sac and at the seat of ligation. This compels a more or less extensive dissection of the sac out of its bed as one of the necessary features of the procedure, in order to secure all the collateral vessels that empty into the sac, unless the uncertain process of plugging the openings and packing the sac itself is resorted to. If the sac is dissected, as is usually done to secure the collaterals, the difficulties of the operation are increased, and the vitality of the limb is endangered by interfering with the collateral circulation which, in many types of aneurism, is most freely developed in the neighborhood of the sac.

(b) Another serious objection to the old Antyllian operation as usually performed is that the sac is allowed to remain as an open cavity in the bottom of the wound, where it is packed or drained and allowed to heal by granulation. This invites infection, suppuration, and its attendant dangers of secondary hæmorrhage; all that is obviated by the author's method of endo-aneurismorrhaphy, which does not disturb the sac from its vascular connections, and favors its prompt obliteration by suturing the infolded walls of the sac, and keeping them in direct and close approximation.

7. The uncertainties and dangers of extirpation of the sac (Purmann's operation) are even more apparent than those of the Antyllus operation, because, in addition to the greater technical difficulties of extirpation, there is much greater risk of injury to the accompanying satellite veins and nerves which blend most intimately with the sac, and often compel the operator to limit his intervention to a partial extirpation, leaving behind a considerable portion of the sac wall in order to avoid injury to important adherent structures. The greatest objection to extirpation, however, lies in the decided interference with the collateral circulation in the immediate vicinity of the aneurism, which entails a considerable risk of mortification in the distal parts. All these dangers are reduced to a safe minimum, and are largely eliminated by simply obliterating the sac, instead of extirpating it.

[NOTE.—In this abridged article the detailed clinical histories of the author's four cases operated upon by the method described in the text have been omitted. The clinical reports are published in full in the volume of *Transactions of the American Surgical Association* for 1902, to which the reader is referred for the complete text and discussion.]

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- ¹ Medical Record, New York, January 16, 1897.
- ² Riforma Medica, 1898, Vol. iv, No. 125.
- ³ Berliner klinische Wochenschrift, 1895, No. 34.
- ⁴ Bulletin Société de Chirurgie, Paris, July 6, 1898.
- ⁵ Gaz. méd. de Picardie, Amiens, 1900, xviii, pp. 16-23 and 85-93.

**CASES ILLUSTRATING SOME IMPORTANT POINTS
IN THE DIAGNOSIS AND TREATMENT OF
ABDOMINAL CONTUSIONS ASSOCIATED
WITH VISCERAL INJURIES.¹**

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CONTUSIONS of the abdominal wall and lower segment of the thorax constitute a fair proportion of the injuries received in the accident rooms of our large general hospitals. These injuries result from a great variety of traumatisms, such as blows, kicks, falls, crushes, railway accidents, and the passage across the trunk of the wheels of a truck or other heavy vehicle. They are not infrequently associated with other lesions, as fractures of the ribs or of the extremities, dislocations, head or spinal injuries, the symptoms of which may completely overshadow those of the abdominal lesion and cause it to be overlooked. In these cases there is frequently no history of an injury to the abdominal wall, no mark of traumatism, and no complaint of abdominal pain.

The results of an uncomplicated abdominal contusion may vary from a slight feeling of soreness or general discomfort, with or without an insignificant bruise or ecchymosis of the skin, to a rapidly fatal collapse. This difference, which is not infrequently observed in injuries quite similar in their method of production, in the amount of force expended and in their outward signs, is due to the presence or absence of associated visceral injury.

The effects of a blow on the anterior abdominal wall are modified by the condition of the abdominal muscles. An unexpected blow on the pit of the stomach received while the muscles are in a state of comparative relaxation is often followed by severe shock, nausea, and temporary muscular weakness, due,

¹ Read before the New York Surgical Society, October 22, 1902.

as Crile has shown, to the concussion being transmitted to the pericardial portion of the diaphragm. If, however, the blow is expected and the abdominal muscles are rigidly set, little or no inconvenience is experienced. The same is true in other parts of the abdomen; an expected blow or contusion produces as a rule less visceral injury than one received while the abdominal wall is relaxed. A blow directly over a distended hollow viscus, as the stomach or urinary bladder, will frequently cause a rupture of that organ, and extravasation of the contained matter, while the same blow received during collapse of the organ would produce no untoward effect.

Enlargements of the liver and spleen to such an extent that they lie below the protecting arches of the ribs favor their injury as a result of abdominal traumatism.

It must be remembered that extensive and fatal visceral ruptures may be produced by comparatively slight contusions, and that the amount of internal injury is due more to the condition of the organ and the protecting abdominal muscles than to the force of the blow.

The lesions produced by an abdominal traumatism may be divided into two general classes,—the *extraperitoneal* and the *intra-peritoneal*.

The extraperitoneal results of abdominal contusions are bruises of the skin; subcutaneous ecchymoses; hæmatomata beneath the skin, between the muscular layers or between the muscles and the peritoneum; rupture of the muscles at their points of attachment or in the intervening portions; contusion or rupture of the kidneys. The intra-peritoneal injuries may be a contusion or rupture of the parietal peritoneum; contusion or rupture of the stomach or intestine; contusion or rupture of the liver, spleen or pancreas, and injury to the omentum or mesentery. Ruptures of the bladder may or may not involve the peritoneal cavity.

In rupture of any portion of the alimentary canal, immediate extravasation of the contained matter will result, producing, as a rule, at first, symptoms of peritoneal irritation, as localized pain, tenderness, vomiting, and muscular rigidity, and

later followed by symptoms of peritonitis, generally of the spreading variety, and characterized by an increase in the severity and area of the pain, tenderness, and muscular rigidity, with fever, prostration, meteorism, and the occurrence of a marked leucocytosis, leading rapidly to a fatal termination, unless speedily relieved by surgical procedures.

Injuries of the liver and spleen following abdominal contusions are generally found to be more or less extensive fractures which result in the extravasation of blood which varies in amount with the extent of the injury. The commonest seat and direction of the fissure in cases of rupture of the liver are along the falciform or coronary ligaments. They may extend to any depth, and often nearly bisect the organ. In the deeper fissures the hæmorrhage may be so rapid and extensive as to produce immediate death or symptoms of complete collapse. In fractures of the spleen, the direction of the rent is generally that of the large blood-vessels, and is therefore from the external surface, the anterior or posterior border of the organ, towards the hilum. On account of the great vascularity of this organ, even small tears frequently give rise to severe and often fatal hæmorrhages. In ruptures of the kidney the line of fracture also corresponds, as a rule, with the direction of the blood-vessels. When limited to the cortex, the hæmorrhage is moderate; but when complete rupture occurs, the larger vessels are torn and the hæmorrhage is profuse, often forming enormous retroperitoneal hæmatomata, and also intraperitoneal extravasations in case that membrane is torn by the original traumatism. When the pelvis or ureter is injured, urinary extravasation necessarily occurs, giving rise to a gradually increasing tumor of the flank, which not infrequently becomes infected, forming extensive perirenal suppuration.

In rupture of the bladder from a blow over the distended viscus, the tear may be extraperitoneal, intraperitoneal, or may be both extra- and intraperitoneal. If the injury is limited to the bladder, the symptoms may be only those of a slight transitory shock and those of moderate peritoneal irritation caused by the extravasation of the urine into the peritoneal cavity.

followed later by a progressive peritonitis. If, on the other hand, the rupture is due to a fracture of the pelvis, the rupture is more generally in the extraperitoneal portion of the bladder, and is frequently caused by the driving inward of a fragment of a broken ramus. The same injury frequently causes rupture of the large vessels of the pelvis, giving rise to a hæmorrhage, which, if severe, may produce symptoms of shock which may completely mask the initial evidences of peritoneal irritation.

Injuries of the omentum and mesentery are rarely found unassociated with other visceral lesions. When present, the symptoms are generally those of extensive hæmorrhage and peritoneal irritation.

The older writers upon surgery were accustomed to refer to shock as the chief symptom of injury of the abdominal viscera, and taught that even slight injuries of the solid or hollow organs of the abdomen were invariably associated with a severe degree of shock. Since surgeons have adopted the plan of early exploratory operation in abdominal traumatism, it has been found that this view is erroneous, and that gunshot, stab, or other limited wounds of the liver, spleen, pancreas, stomach, intestine, etc., unless accompanied by severe hæmorrhage or extensive extravasation, rarely give rise to a more than slight and transitory shock, and that rupture and even severe lacerations of these organs occasionally occurs with no more shock than would be expected from the superficial contusion.

Crile, in his masterly essay entitled "An Experimental Research into Surgical Shock," has shown that certain organs and tissues of the body, when injured, seem to give rise to a far greater degree of shock than others, and in experiments upon the abdominal viscera found that injuries involving the diaphragm, especially that part attached to the pericardium, gave rise to a relatively greater degree of shock than similar injuries elsewhere; that injuries involving the pylorus, duodenum, and upper segment of the small intestine produced more reaction than injuries of the lower portion of the alimentary canal and the solid viscera; that severe traumatism of the female pelvic organs frequently occurred with practically

no evidences of shock, while injuries of the external genitals, especially in the male, produced often a degree of shock seemingly wholly out of proportion to the degree of the injuring force.

In general, he found that "the more specialized and abundant the nerve supply to a part, the more will it contribute to the production of shock when subjected to injury."

The occurrence of hæmorrhage in connection with visceral injury, if extensive, will give rise to an accentuation of the initial shock, and if continuous, will produce progressive weakness, pallor, weak pulse, thirst, restlessness, cold perspiration, air hunger, syncope, and death.

These symptoms, and also those of peritonitis, are valuable when present, but are often absent in the first few hours following the injury, at a time when the diagnosis should, if possible, be made, and any operative procedure for the relief of the condition should be undertaken.

From the observation of some twenty cases of visceral injury following abdominal contusions, verified by operation or autopsy, the writer finds that of the symptoms present in the earliest stages of an abdominal injury, pain, tenderness, and muscular rigidity are the most prominent, and are most to be relied upon to establish the diagnosis. Deep-seated localized pain following an abdominal contusion, especially if increased by pressure and accompanied by local or general muscular rigidity, is one of the most constant symptoms of intra-abdominal injury. The association of these three symptoms is almost pathognomonic of peritoneal irritation. Pain, however, is often present with tenderness in injuries limited to the abdominal wall, but in these cases the muscular rigidity is generally absent. In the absence of spontaneous pain, localized tenderness with rigidity is strongly suggestive of visceral injury. Of the three symptoms, however, muscular rigidity is the most reliable, and is sometimes the only sign present. In the absence of other diseased conditions, spasm of one or more of the abdominal muscles following a traumatism may be looked upon as nature's effort to protect an injured organ from further irritation.

Vomiting is a symptom occasionally present in abdominal injuries. It is not, however, as formerly taught, always the accompaniment of a severe visceral injury. It is commonly present in injuries involving the stomach and upper part of the intestinal tube, and in injuries accompanied by severe shock.

The occurrence of free fluid in the peritoneal cavity, evidenced by the presence of flatness in the flanks which disappears when the patient is turned to the opposite side, is a valuable sign when it can be demonstrated. The presence of a large amount of fluid faeces in the colon may rarely give rise to the same signs and lead to error. Free gas in the peritoneal cavity is also a valuable indication of rupture of the alimentary canal. In the absence of meteorism, this would be indicated by abnormal tympanites and an obliteration of the liver dullness.

Regarding the possibility of a more specialized diagnosis, it is the writer's experience that in these severe injuries the signs and symptoms are rarely so localized and characteristic as to warrant a positive diagnosis of the exact nature of the lesion. It occasionally happens, however, that the signs point strongly to injury of one or the other of the viscera.

If, following an abdominal contusion with or without evidences of superficial injury, there are localized pain and rigidity over the epigastrium with the presence of free gas in the peritoneal cavity, a rupture of the stomach may be suspected. If, under the same circumstances, there is pain and tenderness limited to the right hypochondriac region and rigidity of the upper half of the right rectus muscle, with free fluid in the peritoneal cavity, and with a progressive weakness, pallor, cold perspiration, restlessness, air hunger, thirst, and a rapid, weak pulse, rupture of the liver with severe hæmorrhage is to be inferred. The same symptoms and signs limited to the left hypochondrium suggest a rupture of the spleen. Pain and rigidity about the umbilicus or in the lower part of the abdomen without other symptoms suggest rupture of the intestine. The diagnosis is rendered more probable if, in addition, free gas can be demonstrated in the peritoneal cavity.

Pain in the hypogastrium, with vesical tenesmus and the passage of a small amount of bloody urine or an empty bladder, indicates rupture of that organ, while pain in one flank, with hæmaturia and the formation of a retroperitoneal exudate, suggests contusion or rupture of the kidney.

To illustrate the above-mentioned points in the special diagnosis of these injuries, I desire to report briefly a few cases selected from a much larger number operated upon during the past three years, which will furnish examples of both typical and atypical cases of the several classes.

CASE I.—Rupture of the liver, exhibiting symptoms and signs sufficiently typical to warrant a probable diagnosis.

A. B., male, aged forty years, was admitted to the Roosevelt Hospital in the fall of 1890, having sustained a severe contusion of the right side of the thorax and abdomen. On admission he exhibited the evidences of severe shock,—pallor, cold extremities, a weak, rapid pulse, cold perspiration, and great restlessness. The abdomen was everywhere rigid; tenderness was present over the lower portion of the right thorax and in the right hypogastrium. There was flatness in both flanks, which disappeared on changing the position of the patient. Liver dulness present; bladder emptied by catheter; no hæmaturia. The patient had vomited once or twice.

After vigorous stimulation and a hasty preparation of the abdomen, chloroform was administered, and the abdomen opened by an incision through the outer border of the right rectus muscle. The peritoneal cavity contained a quart or more of fluid blood and clots; a large rent was found in the convex upper surface of the liver, which was packed with gauze. The abdomen was cleansed by washing with a large amount of normal salt solution and the wound partly closed.

The patient rallied well after the operation, and for four days appeared to be progressing favorably. The temperature remained at or near the normal line, and the pulse gradually diminished in frequency and improved in volume and force. He took nourishment and the bowels moved. On the fourth day the temperature and pulse rose; tympanites and vomiting appeared, and he subsequently died of peritoneal sepsis.

CASE II.—A brakeman, twenty-eight years of age, received a blow on the abdomen in a railway accident. He was unconscious for a few moments as a result of the blow, but quickly recovered, and when brought to the hospital complained only of pain at the umbilicus. There was no vomiting. He was somewhat pale, the pulse was rapid, but showed no other evidences of marked shock. Examination showed well-marked rigidity of the right rectus muscle and tenderness over its upper third. Dulness in both flanks. The patient did not give the appearance of one severely injured, and considerable difference of opinion existed among those of the staff who examined him as to whether he had a visceral lesion or only a severe contusion of the abdominal wall. He was, however, immediately prepared for operation, and under ether anæsthesia an incision was made through the upper portion of the right rectus muscle and the peritoneal cavity opened. As soon as the peritoneum was incised, a large quantity of blood escaped, apparently from the direction of the pelvis. The incision was hastily enlarged, so that it extended from the thorax to the pelvis, and the intestines retracted, exposing the pelvic cavity, which was filled with clotted blood. This was hastily removed, but quickly refilled. Considerable time was lost in attempting to find the bleeding point in this region, and after it was demonstrated that none was present, but that the blood escaped from above, the ascending colon was followed upward and the small intestines retracted to the left. As soon as this was done, there was a gush of black blood, apparently from the upper part of the vena cava, which exceeded in quantity and rapidity of outward flow anything which I have ever seen in my surgical experience. The patient was quickly exsanguinated, and was kept alive only by the most energetic stimulation by intravenous infusion, the hypodermic use of whiskey and strychnine, and an enema of hot coffee. The hæmorrhage was temporarily arrested by gauze packing, and after a more thorough examination the vena cava was found to be intact, and the source of the hæmorrhage was an enormous rent in the right lobe of the liver, along its falciform and right coronary ligaments, which allowed the greater portion of the right lobe to hang downward, as on a hinge. This was hastily packed, the abdomen cleansed, and united with interrupted silk-worm-gut sutures.

The hæmorrhage was completely arrested by the packing and

upward pressure of the right lobe, but the patient never rallied, and died within twenty-four hours.

This case is an excellent example of a class of which the writer has seen several examples, where the symptoms and signs gave no adequate idea of the extent of the injury. Were it not for the presence of well-marked muscular rigidity, the patient would in all probability have been treated by the expectant method.

CASE III.—This is a case of rupture of the spleen with fairly typical symptoms.

G. B., an Italian, eighteen years of age, was injured by falling from a trolley-car, striking the lower left portion of the thorax and adjacent abdominal wall against an elevated railway post. He experienced severe pain in the region of the spleen and felt weak. He was brought to the hospital in an ambulance. On admission he looked pale; the pulse was rapid and weak; the breathing was shallow, and there was general abdominal tenderness and rigidity of the muscles. As the condition seemed to improve somewhat after the patient had been placed in bed, the attention of the writer was not called to the case until the following morning. At that time the patient presented the typical appearances of one having a severe visceral lesion, with hæmorrhage. There was marked pallor, the face was bathed in cold perspiration, the countenance was anxious, the ears were white and waxy in appearance, the extremities were cold. The patient was restless, thirsty, and suffered from air hunger. The pulse was rapid, varying from 110 to 130, weak, and compressible. The abdominal muscles were rigid. There was marked tenderness over the upper left quadrant.

No free fluid could with certainty be detected. He was immediately prepared for operation, and under ether anæsthesia an incision was made through the upper half of the left rectus muscle. On opening the peritoneum, a large amount of fluid blood escaped, which apparently came from the region of the spleen. This was with some difficulty drawn into the wound, and was found to be greatly enlarged (at least twelve inches in its long diameter). In the middle of the organ there was a transverse tear extending from the periphery nearly to the hilum. A mass of gauze was placed in the rent, and the lower end allowed to protrude through an incision just below the twelfth rib. The spleen was replaced, and the abdominal cavity thoroughly washed out with a large amount of sterile salt solution. Consider-

able reaction followed the operation. The temperature was elevated and the pulse extremely weak and small, and there developed a considerable distention of the abdomen. He was again infused, and had a number of rectal irrigations with hot saline and hypodermic stimulation. He vomited at intervals for two days, after which time there was a gradual improvement in all his symptoms. The temperature fell to the normal, the pulse improved in quality and diminished in frequency, the bowels moved, the abdominal distention subsided, and his condition seemed in every way satisfactory. At the end of a week there occurred a gradual rise in temperature, with headache, foul tongue, and apathy, but without leucocytosis. His wound was dressed and found to be in a satisfactory condition. There was no sign of peritonitis. His condition so strongly suggested typhoid fever, that a Widal test was made with positive result. It was then learned that at the time of his accident he was just recovering from an attack of typhoid fever, which accounted for his enlarged spleen, and also for his secondary rise in temperature, which we regarded as a relapse occasioned possibly by the traumatism. His symptoms gradually increased in severity, and he died during the second week.

CASE IV.—Another case of rupture of the spleen, but with atypical symptoms.

C. C., aged fourteen years, a school-boy, was thrown from his bicycle, striking a rock. The contusion occurred over the region of the lower ribs on the left side. He experienced some pain in the abdomen and vomited once, after which he felt relieved and walked home, a distance of over a mile. He went to bed, and the pain was relieved to some extent. The following morning he again had pain in the abdomen and walked to the hospital, a distance of two or three blocks from his home. On examination after his admission to the hospital, his pulse was found to be 116, temperature slightly above the normal, countenance pale, but no other evidences of shock. The abdomen was rigid and tenderness existed in the region of the umbilicus and somewhat to the left. There was no dullness in the flanks and no evidence of free gas in the peritoneal cavity. He was immediately prepared for operation, and, after starting an intravenous infusion, an incision was made through the upper part of the left rectus muscle. As soon as the peritoneal cavity was opened, free blood escaped in large

quantities. The incision was enlarged and the small intestines withdrawn from the cavity, which enabled us at once to locate the source of the hæmorrhage as a transverse tear through the middle of the spleen. As the condition of the patient was extremely critical in spite of an abundant infusion and the most vigorously hypodermic and rectal stimulation, a mass of gauze was hastily thrust into the rent, and the spleen replaced and pushed snugly against the diaphragm. The abdomen was quickly cleared of clots, washed out, and the wound partly united with silkworm-gut sutures, the end of the gauze packing being allowed to emerge through the upper angle of the wound.

During the next three or four days the patient was kept alive only by the most generous stimulation and repeated saline infusions. The gauze was subsequently removed through an incision in the flank, made under anæsthesia, and he made a good recovery. In this case, also, the symptoms and signs even after eighteen or twenty hours gave one no idea, or even a suggestion, of the extent or gravity of the injury. The diagnosis of visceral injury was made from the history and presence of tenderness and well-marked muscular rigidity.

CASE V.—A schoolboy, six years of age, while playing about a room, overturned a table, the edge of which struck him over the upper part of the abdomen. The blow caused considerable pain, and he complained of feeling very weak and faint. He was brought immediately to the hospital, and on admission his pulse was found to be 100 and the temperature slightly subnormal. There was pallor, cold extremities, perspiration, and the child appeared in a condition of moderate shock. On examination the abdomen was found to be rigid. Tenderness existed in the region of the umbilicus. No evidence of free fluid or gas in the peritoneal cavity. The diagnosis of rupture of the intestine was made by one of the house staff, and a median incision made extending from the ensiform to the umbilicus. As soon as the peritoneum was incised, free blood, gas, and intestinal contents escaped. The lesion was found to be a double rupture of the jejunum about six inches from the duodenojejunal flexure. The ruptures were entirely separated from each other, and each involved the entire circumference of the gut, leaving a segment four inches in length attached only to the mesentery. Considerable hæmorrhage had taken place from the wounded mesenteric vessels.

The unattached segment of gut was removed and the upper and lower openings of the jejunum united with a small Murphy button. The abdomen was cleaned and united. The child continued in a condition of profound shock for twenty-four hours, and died.

Although in this case the symptoms were fairly typical, the degree of shock was surprisingly slight when we consider the extent of the lesion.

CASE VI.—A man, thirty-eight years of age, was struck in the middle of the abdomen by a falling bale of paper. He experienced considerable pain at first, but soon recovered, and after his admission to the hospital he presented no evidences of shock. The pulse was between 60 and 70 and of good quality; there was slight tenderness over the epigastric and hypogastric regions, and an appreciable degree of muscular rigidity. No vomiting; no signs of free fluid or gas in the peritoneal cavity. A diagnosis of visceral injury was made and an immediate operation advised. This was indignantly refused, and the patient insisted that he felt perfectly well, and was suffering only from a slight bruise of the abdominal wall. During the following night the pain increased, and the patient became restless and feverish. The next morning he appeared seriously ill. The abdomen was distended and tympanitic; the liver dulness was not entirely obscured. Tenderness and rigidity were everywhere present. There was flatness in both flanks, which disappeared on changing the position of the patient. The blood count showed 16,000 leucocytes.

Although it was recognized that the outlook was then well-nigh hopeless, at the patient's request the abdomen was opened under ether anæsthesia. As soon as the peritoneal cavity was entered, a large amount of gas and foul-smelling, cloudy fluid escaped, which was found to be a mixture of seropus and intestinal content. The intestines in the lower half of the abdomen and pelvis were injected and covered with a fibrinous exudate. A large perforation was found in the lower third, through which gas and faecal matter were constantly escaping. Several other severely bruised and ecchymotic areas were found on various coils of the small intestine. The rupture was united with two rows of Lembert sutures, the peritoneal cavity thoroughly irrigated, and the wound closed with two cigarette drains,—one leading to the pelvis and one to the right flank. The patient was infused and

generously stimulated. He did exceedingly well for more than a week. The temperature and pulse fell to the normal; the distention and rigidity disappeared; the bowels moved, and the patient took plenty of fluid food. About the tenth day he began to complain of pain and to develop signs of a rapidly spreading peritonitis, and died two or three days later. On autopsy, the original perforation was found to be healed, but a second perforation had occurred at the site of one of the many contused areas seen at the time of the operation.

This patient would undoubtedly have recovered had it not been for the secondary perforation.

CASE VII.—A negro boy, four years of age, was admitted to the hospital in August last, a short time after a contusion of the left flank and abdomen caused by falling down a flight of stairs. There was comparatively little evidence of shock, so little, in fact, that the child fell asleep soon after the injury, and the parents did not consider the question of seeking medical advice until it was noticed that the boy passed bloody urine.

On examination there was found only a slight tenderness over the left lumbar region. There was no evidence of free fluid in the peritoneal cavity and no rigidity of the abdominal muscles. The child had not vomited, and made no complaint unless handled.

A diagnosis of severe contusion or rupture of the kidney was made, and the child immediately prepared for operation. Under chloroform anæsthesia an oblique lumbar incision was made exposing the kidney, which was found surrounded by a large mass of clotted and fluid blood and with a decidedly urinous odor.

When the kidney was exposed, a transverse fissure was found at the junction of the upper with the middle third of the organ. The fissure extended from the external border to the hilum, freely opening the pelvis. In fact, the upper segment was only attached to the lower portion of the kidney by a narrow pedicle. The parts were thoroughly disinfected with peroxide of hydrogen and salt solution, and the upper segment replaced against the lower and sutured with catgut. The external wound was united with drainage and the dressings applied.

The child reacted well from the operation. The hæmaturia ceased at the end of twenty-four hours, and recovery was uneventful.

CASE VIII.—A middle-aged man received a crushing injury

about the pelvis, and was brought to the hospital in the ambulance. When admitted he seemed in a condition of mild shock only, and complained of slight pain about the right hip, buttock, and lower part of the abdomen. Examination revealed at first only multiple contusions. Urine passed immediately after his admission was clear and normal in appearance. A little later he was catheterized, and a small amount of bloody urine was withdrawn. A careful re-examination revealed a fracture of the pelvis and slight rigidity of the lower portion of the right rectus muscle, and a distinct tumor occupying the right half of the pelvis. As the patient seemed to be passing rapidly into a condition of deeper shock, and as the pulse was becoming more rapid and weak, he was prepared for operation. After the administration of the anæsthetic, the catheter was again passed, and to our astonishment a considerable quantity of clear urine was once more obtained. We were wholly at a loss to account for the intermittent hæmaturia, but as his condition was rapidly becoming one of great gravity, and as there was an evident lesion of some kind on his urinary tract, an exploratory laparotomy was hastily performed. On opening the abdomen, an enormous retroperitoneal hæmatoma was found occupying the right half of the pelvic cavity and extending well up over the iliac muscle. On incising the parietal peritoneum, a vertical fracture of the right innominate bone was found just anterior to the sacro-iliac joint, a rupture of one or more of the larger branches of the internal iliac vein, and a complete transverse rupture of the right ureter. As soon as the peritoneum was incised and the clots turned out, the hæmorrhage was very profuse, and was controlled with great difficulty, owing to the deep position of the bleeding vessels and the difficulty in keeping the field clear. (The Trendelenburg posture was not employed.)

After the hæmorrhage was finally arrested, the ureter was anastomosed by the Van Hook method and the abdomen closed with drainage. The patient never rallied from the shock.

CASE IX.—Male, aged twenty-five years, was brought to the hospital in a state of severe shock after a crushing injury to the region of the pelvis by being rolled between a car and brick wall. He complained of great pain about the pelvis, which was accentuated by any movement of the trunk and legs; also a strong desire to urinate. On examination there was observed mobility and crepitus, easily appreciated whenever the iliac crests or other

portions of the pelvis were moved. Tenderness was well marked in the hypogastric region, and a semisolid tumor was appreciated just above the pubic symphysis.

On catheterization the bladder was found to contain only a very small amount of bloody fluid; previous spontaneous efforts at urination had been ineffectual.

The pulse was rapid and weak, the temperature subnormal, the patient was apathetic and could give no intelligent account of the accident. He was immediately prepared for operation. Under ether anæsthesia, an incision was made in the median line just below the umbilicus and the peritoneal cavity opened, for purposes of exploration. Through this incision it was easily demonstrated that there was no intraperitoneal rupture, but that there was an enormous hæmatoma of the prevesical space extending more to the right than to the left side. The abdominal wound was immediately closed and the prevesical space opened by an extension downward of the original incision. A large amount of clotted blood was found and removed, after which the hæmorrhage from the deeper portions of the wound was very free, which necessitated immediate packing and the administration of a large intravenous saline infusion and other stimulating measures.

As soon as hæmorrhage was controlled, further examination revealed a transverse fracture of the horizontal ramus of the pubis on the right side, one fragment of which was directed inward and lay within the cavity of the bladder, passing through a ragged tear in its anterior wall which extended well downward to the prostatic portion. The displaced fragment of bone was forced back into position and sutured to its fellow by heavy chromicized catgut, the tear in the anterior wall of the bladder was sutured with two or three layers of catgut, and a small opening for drainage made in the summit of the bladder. These procedures were extremely difficult to carry out, especially the suturing of the deeper portion of the bladder wound, and consumed considerable time. It was my original intention to establish perineal drainage, as there was evidence of injury to the deep urethra and triangular ligament, but before this could be done, the condition of the patient became so critical that the operation had to be abandoned, and we were obliged to hastily pack the wound and place the patient in bed. Several infusions were given and every known method of stimulating resorted to to save his

life. He remained in a condition of severe shock for many hours, and then slowly improved. The wound became badly infected in spite of constant irrigation and frequent dressings. Several days later he was again etherized and a perineal opening made into the urethra, through which the bladder was drained; another drainage tube was passed through the perineal wound upward through the triangular ligament above the prostate to drain the foul pre-vesical space. These tubes were left in place for several weeks, until the wound was clean and until the suprapubic bladder wound, which had sloughed extensively, was beginning to close. They were then removed and the perineal opening was allowed to heal. Sounds were passed to preserve the patency of the urethra.

The suprapubic opening, however, persisted, owing to its large extent, and as a result a condition of contraction of the bladder gradually developed. The urethra recontracted, and the passage of sounds became more and more difficult. A second external urethrotomy was performed, and the bladder drained for several weeks in the hope that the fistula would close. This was finally abandoned and the perineal wound allowed to heal.

Efforts were then made to dilate the bladder by injecting each day as much boric acid solution through a catheter as the bladder would hold, preventing egress of the fluid through the suprapubic wound by digital compression. By this means the bladder capacity was increased in thirty days from one and one-half ounces to five and one-half ounces. He was then discharged, and told to report once a week for sounds, in the hope that the suprapubic fistula would heal spontaneously.

During his absence from the hospital the bladder became badly infected, and he developed a pyelitis on the right side. Sudden plugging of the upper extremity of the ureter by a calculus caused an acute attack of pyonephrosis, which brought him back to the hospital. On admission his temperature was 104° F.; pulse, 130. He was suffering from a severe aching pain in the right flank, which was the seat of a large oval tumor.

Nephrotomy was immediately performed, and about twenty ounces of pus and an obstructing ureteral calculus removed.

Two months later a plastic operation was performed on the suprapubic opening, which narrowed it to the size of a darning-needle.

Later it closed, and with the exception of a contracted bladder the patient is in excellent health.

Visceral injuries of the types illustrated by the foregoing cases are for obvious reasons necessarily fatal unless promptly relieved by surgical measures.

In many of these cases the condition of shock, even after the occurrence of the severest lesions, is during the first few hours surprisingly slight, and one must not judge of the gravity of the injury by the degree of initial shock.

Pain, tenderness, and muscular rigidity are often the only symptoms during the first few hours after the receipt of the injury, and the occurrence of these three symptoms following an abdominal traumatism should be regarded as a positive indication for an exploratory laparotomy. To delay exploration for the occurrence of other more characteristic and localized symptoms is but to invite disaster, as the resistance of the individual after the receipt of the severe visceral injury diminishes with every hour of delay, and the only hope of his being able to withstand the added shock of a severe surgical operation is to inaugurate the treatment at the earliest possible moment.

Time will not permit a detailed consideration of the treatment in these injuries which has been somewhat outlined in the report of the cases.

The plan of treating extensive fractures of the spleen by pressure and packing with gauze, rather than by splenectomy, has already been brought to the attention of the Society, and is applicable also to the liver. The writer believes that it is equally as effective in arresting hæmorrhage; it is accompanied by less shock; it saves time, and preserves an important organ.

In these cases, perhaps more than in any other conditions, success will depend upon speed of operation, perfection of technique, and the ability to administer at any moment the most vigorous stimulation. It has been the writer's experience in several cases accompanied by severe intraperitoneal hæmorrhage, exhibiting comparatively slight evidences of shock, that as soon as the peritoneum was incised and the intra-abdominal pressure was relieved, the patient passed rapidly into a state of profound collapse.

In all of these cases an assistant should expose one of the

large veins of the arm and introduce a cannula as soon as the patient is under the influence of the anæsthetic, and be prepared to administer the saline infusion at the time the peritoneal cavity is opened.

The use of the Trendelenburg posture, enemata of hot coffee, and the hypodermic use of strychnine, atropine, and whiskey, should also be employed at an early period.

INTRAPERITONEAL RUPTURE OF THE BLADDER.

WITH REPORT OF TWO RECENT CASES OF RECOVERY AFTER SUTURE.

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PREVIOUS to 1883, when Mr. Walter Rivington¹ gave the Hunterian Lectures on this subject, it was the opinion of most men that intraperitoneal rupture of the bladder was fatal, whatever might be the treatment. Mr. Rivington spent much time in showing that no genuine case of intraperitoneal rupture had recovered up to that time, yet said that he did not absolutely despair of success in the future with the aid of aseptic surgery.

In 1883 McCormack operated successfully upon two cases, and in 1888 Dr. H. H. Grant² published a case of intraperitoneal rupture of the bladder with suture,—the first successful case in America. This case has unfortunately been left out of all previous papers published on this subject. Walsham, in 1888² and 1895,³ published papers on the subject, and with the aid of Miles tabulated the cases up to these dates. It was in the 1895 paper that he recommended the injection of air into the bladder as a means of diagnosing intraperitoneal rupture of the bladder.

Kerr⁴ in 1893 tabulated cases, and in 1901 appeared an excellent paper by Dr. Samuel Alexander⁵ tabulating all the cases published by Walsham and Kerr, and including several omitted by these men.

In going over the cases again, I found four cases that were omitted by Dr. Alexander in his tables, and three that were published after his report. Two are published for the first time in this paper. Thus we have nine cases to add to Dr. Alexander's table, making a total of fifty-four cases of intraperitoneal rupture treated by suture.

In these fifty-four cases there were twenty-six deaths and twenty-eight recoveries, *i.e.*, a death-rate of 48 per cent. If, however, we divide the cases into two arbitrary periods, taking the last ten years as one period, and all cases published previous to that time as another, we have a very much more encouraging outlook. That is, in thirty-two cases published previous to 1893 there were but twelve recoveries, giving a death-rate of $63\frac{1}{2}$ per cent., while in twenty-two reported since 1892 there were fifteen recoveries, giving a death-rate of $27\frac{1}{2}$ per cent.

If we look for the cause of death in these cases, we find that it is generally peritonitis, shock, or hæmorrhage; but by far the most common cause is peritonitis. Of twenty-six deaths, seventeen were owing to peritonitis, and in four of these cases the peritonitis developed subsequent to the operation. That the element of time must play an important part in such a condition cannot be denied; yet there must be other factors which are more important, as shown by the following figures. Of the twelve recoveries in our first period,—that is, previous to 1893,—we find that the average duration of time between the accident and the operation was twenty-three and one-fourth hours; whereas in the second period the average time was twenty-seven and one-fourth hours. In the cases in which death resulted there was a lapse of thirty-three and one-third hours before operation in the early period, and thirty-one hours in the second period,—that is, after 1892. There were also in the second period two cases, one⁶ operated upon ninety hours after injury and another⁷ eighty-nine hours after injury, in both of which recovery followed.

We have then an improvement in the death-rate of 36 per cent. in the second period over the first, and yet the average interval between the injury and the operation has increased four hours instead of diminishing, as we should expect.

The improvement in the death-rate, *i.e.*, a diminution in the number of cases of peritonitis in the second period, is certainly not owing to earlier recognition of the cases, but rather, it seems to me, to an improvement in the technique of the operation and to the exercise of more care in methods em-

ployed in making a diagnosis, *i.e.*, catheterization and the injection test.

The cases of peritonitis may be divided into four classes: (1) Those in which the bladder is already infected at the time of the accident; (2) Those in which the bladder and the peritoneum are infected by catheterization or by injection tests; (3) Those in which the peritoneum is infected at the time of operation; (4) Those in which the peritoneum is infected by leakage of the urine after the operation.

(1) The first group of cases cannot be reduced to any great extent; such cases can be saved only by immediate operation, and only occasionally then. This group, though small, will always be a constant one, as a considerable proportion of cases of ruptured bladder occur in drunken men, and these men are the ones most liable to gonorrhœa and its sequelæ, among them infected bladder. These cases compose the class upon whom it is most necessary to operate immediately, and yet this can be seldom done because the patients must recover from the effects of their drink before they have sense enough to present themselves for examination.

(2) In the second group of cases it seems to me that we find the cause for another considerable number of peritoneal infections. Careless catheterization is so easy, and perfect asepsis in such cases so difficult, that catheterization should be one of the last instead of one of the first things to be done. The injection of boracic acid or salt solution is still more dangerous. The catheter is put into the bladder, pushing infected material in the urethra before it. This material—including bacteria from the inside of the catheter, if it has not been boiled—is washed into the abdomen through the opening in the bladder. When we consider that we have the basin, the solution, the syringe, the catheter both inside and out, and the urethra to sterilize before we can be sure that we are not introducing bacteria into the peritoneal cavity, it is easy to believe that the injection test is a dangerous procedure. Owing to the irritation caused by the urine, it takes very few bacteria to start a general peritonitis. Cases of this class are no doubt becoming

more infrequent, but there must still be room for improvement. A striking fact in connection with this subject is that, even with an increase of four hours in the interval between the injury and the operation in the second period over the first, we have peritonitis present at the time of the operation in 31 per cent. of the cases in the first period and in but 18 per cent. of the cases in the second period,—that is, since 1892. To what can this be owing but to more careful asepsis in the use of the catheter and of the injection test?

(3) Infection of the peritoneum at the time of operation has been decreased to a considerable extent by improvement in technique, but this is a contingency which may happen at any time, even in the hands of the most careful surgeons.

(4) Peritonitis owing to leakage is always going to be a danger, for, in spite of the greatest care in the suturing of wounds, occasionally one will leak. Walsham reported a case in 1888 in which leakage was due to giving way of catgut sutures. Careful suturing with silk through the peritoneal and the muscular coats only, with proper abdominal drainage, will reduce the death-rate in this class of cases.

The second most important cause of death is shock. Dr. Alexander reports three out of twenty-three deaths as due to this cause. The improvement in operative technique should diminish this death-rate somewhat; but many of these patients are alcoholics, who stand operations badly, and who are at the time of operation in a condition of considerable shock owing to injury and abdominal pain. In many reported cases the time spent on the operation is given as either two or three hours, which seems unnecessarily long, except in the most complicated cases. The time required for the entire operation should not exceed forty-five minutes.

Hæmorrhage is such a rare cause of death that it need not be considered here.

Pathology.—The theory that the peritoneum, which is not nearly so elastic as the muscular and mucous coats, gives way early and carries with it the muscular coat seems to be

exemplified in the case reported by Ewing,⁸ in which there was a rupture of the peritoneal and muscular coats without rupture of the mucous coat.

Technique.—There are some points in technique which seem worthy of mention. Dr. Alexander's suggestion of first opening the prevesical space is a good one, and will undoubtedly save opening the peritoneum in some cases.

The ease with which the suture of the bladder wound is accomplished depends largely upon the position of the patient. The incision should be made with the patient flat, after which the Trendelenburg position should be used and the intestines walled off with large gauzes. The fear of infecting the abdomen by this position is hardly worthy of consideration, unless the patient has been kept in the upright position from the moment of the accident and until every drop of urine has been gotten out of the abdomen. This, of course, is an impossibility.

Walsham speaks of the difficulty of suturing the lower end of the wound. This can be obviated largely by putting the patient in the Trendelenburg position, by leaving the ends of each successive suture long, and by beginning to suture at the upper end of the wound. By this means the wound is pulled up within easy reach, and each suture below can be placed without difficulty. A round, full-curved needle in a needle-holder with a long handle, which can be held with the fingers instead of the whole hand,—*i.e.*, an elongated hæmodynamic with short powerful jaws,—makes the suture a comparatively easy one.

Suture material should be strong enough to hold a considerable strain for several days, and should be easy to handle. Fine twisted silk seems to be, on the whole, the most satisfactory material.

After the sutures are placed, many surgeons use the injection test for their line of sutures. This seems an unnecessary delay and an unnecessary strain upon the sutures. We suture intestines without any test of our line of sutures, and why should we delay here? Drainage of the abdomen is by far the

safer method, and gauze drainage is preferable to tubes. Gauze will not only effect a walling-off of the sutured region, but by adhering to the bladder wall will relieve the sutures of a great deal of strain during the first four or five days. If the gauze is not taken out too soon, the pulling will not injure the wound in any way. When we use drainage, we may not get such brilliant results as we should if we should close the abdomen at once; but is not the patient's life of more importance than a brilliant result? Alexander reported four cases of peritonitis due to leakage of the bladder wound.

The published cases do not help us on the question of drainage of the bladder, as all methods have been used, but none often enough to give us any definite results. The tendency has been, however, towards either catheterizing the patient or making him urinate at frequent intervals. Perineal drainage has few advocates at the present time. Dohrn thinks that there is less danger of infection if a sterilized catheter is put in for constant drainage than if the patient is catheterized at frequent intervals.

To the records of cases already published, I am able to add two new ones of recovery after suture which have come under my personal care. Their history is as follows:

CASE I.—The following is a brief history of the case as it was sent to me by Dr. N. C. King, of Campello, who had charge of the patient before operation.

A. B., aged twenty-seven years, while hurrying for a car on the evening of October 22, 1901, ran against a post. There was sudden severe pain in the pelvic region with an intense desire to urinate. He walked about 150 yards, boarded a car, and rode over a mile, then walked a quarter of a mile to his home, where he was seen three hours later by a physician. There was no severe shock or collapse. He vomited three or four times. Pulse and temperature were normal. He urinated three or four hours before the accident.

The patient was seen by Dr. N. C. King, October 23, at 1 P.M. Pulse, temperature, and respiration were then normal. The patient had not slept at all. He complained of pain in the region of the

bladder and on the right side as far as the lumbar region. There was some rigidity in the iliac region. Desire to urinate was still present, but he was unable to void any urine. Patient catheterized, about five ounces of bloody urine withdrawn, but with no relief. Diagnosis of ruptured bladder was made, with the supposition that it was extraperitoneal.

October 24, 8 A.M. Did not sleep at all during the night, although morphine, one-quarter grain, was given every five hours. Patient catheterized, about one quart of bloody urine withdrawn. No dulness could be detected at the sides of the bladder or over the bladder. Still had severe pain in the pelvic region and desire to urinate, with occasional vomiting.

October 24, 6 P.M. Catheterized patient and obtained four ounces of urine, somewhat bloody.

October 25, 8 A.M. Slept one or two hours with aid of morphine. Symptoms same, but no vomiting. Temperature, normal; pulse, 90. Appearance of face not so good. Takes no nourishment. Patient catheterized, five ounces of urine withdrawn.

October 25, 9 P.M. Obtained five or six ounces with catheter. Patient had to sit up in bed because of severe abdominal pain when lying down. When sitting up, dulness over bladder region, half-way to umbilicus. Pulse, 100; temperature, normal.

The patient was sent to the Brockton City Hospital, where I first saw him about noon, October 26. His temperature was normal, pulse 110, and very feeble. There was an ashen hue to the face, and the eyes were sunken, with dark lines under them. There was general abdominal tenderness and distention, but little rigidity. Marked tenderness over lower abdomen, which bulged as the patient sat propped up on pillows. The bulging area, which extended about half-way to the umbilicus and into both flanks, was flat on percussion. The patient would not lie down because of the increased pain in the recumbent position. A diagnosis of ruptured bladder was made at once and the patient etherized.

Operation.—An incision of four inches was made in the median line from the pubes upward. When the subperitoneal tissue was reached it was found to be infiltrated with urine, so the prevesical space was first examined, but no more infiltration was found here than above. The peritoneal cavity was then opened; the intestines were distended and very much congested, but were nowhere roughened, except one coil in the posterior

cul-de-sac. The cloudy, slightly bloody urine which filled the abdomen was sponged out of the pelvis, and the intestines were held back with gauze until the bladder could be examined. On the posterior wall of the bladder, exactly in the median line, was a vertical gaping wound between two and three inches long.

The patient was now put in the Trendelenburg position and the intestines were walled off with gauze. This gave a beautiful view of the posterior wall of the bladder. The rent was closed by two rows of interrupted Lembert sutures of silk, beginning at the top of the wound. The bladder was held up by the upper sutures while the next lower suture was placed. The first row included the muscular and submucous coats, and the second row included the peritoneum and the muscular and submucous coats. No injection test was tried. The patient was lowered and the abdominal cavity again wiped out and flushed with salt solution. A gauze wick was placed extending from the posterior cul-de-sac upward over the wound in the bladder and out through the abdominal wound, which was closed by through and through silk-worm-gut sutures.

The patient throughout the operation was in a very wretched condition, and while trying to vomit before he was fully etherized had scarcely strength enough to begin breathing again. Everything was done in the most rapid way possible. The time occupied by the operation was about twenty-five minutes.

A catheter was put into the bladder through the urethra for constant drainage, but, as the patient kept pulling it out, it was left out at the end of the first twenty-four hours, and he was catheterized every four hours for twenty-four hours longer. He was then allowed to urinate voluntarily every four hours.

The patient made a perfectly uneventful recovery,—the wick was out entirely at the end of a week. There was no leaking. In July, 1902, the patient was perfectly well.

CASE II.—A. C., aged twenty-six years, walked into the Carney Hospital, September 12, 1902, complaining of pain in the abdomen. He was admitted to the medical side, and during the afternoon I was asked to see him. He was then in a partially reclining position in bed; and complained of severe abdominal pain without remissions, constant desire to urinate, and constant nausea. He said that on the previous evening, at about ten o'clock, he had had a movement of the bowels and had urinated. He then went to bed, and soon had a severe pain across the lower part of

the abdomen, with nausea and a desire to urinate,—all of which persisted during the night.

The abdomen was generally tender, but very rigid only during palpation. The flanks were dull, and the right side, towards which the patient was turned somewhat, bulged slightly. The pulse was 100; temperature, 98° F. A catheter was introduced and about one drachm of bloody urine obtained.

The patient was then asked again as to his condition on the previous evening and as to any injury, but he said that he had told the truth and had sustained no injury of any kind.

The injection test was not tried because the diagnosis seemed fairly clear, and we think it an unnecessary risk in most cases.

Operation.—The patient was sent to the operating-room, etherized, and prepared for operation. An incision was first made in the median line over the bladder. The subperitoneal fat was infiltrated with blood in all directions, and the peritoneum was found to be bulging at the upper part of the wound. The abdomen was therefore opened and was found filled with bloody urine. As this escaped, the peritoneum over the posterior wall of the bladder was seen to be infiltrated with blood and torn. About two inches from the superior peritoneal fold was an opening into the bladder which looked like a punctured wound, but when straightened out was found to be about one and one-half inches in length. The peritoneum was torn for about an inch below and above the wound. The patient was now put in the Trendelenburg position, the intestines were walled off with gauze, and the wound in the bladder was closed by a row of Lembert sutures of silk through muscular and submucous coats, after which a second row was placed, including the peritoneal, muscular, and submucous coats. The ends of the upper sutures were left long until the one next lower was placed and tied, as in Case I. The patient was now lowered and the abdomen flushed with salt solution. A gauze wick was put into the pelvis extending up over the wound in the bladder. The abdominal wound was closed with silkworm-gut sutures through and through.

The time occupied by the entire operation was thirty-five minutes. The patient's pulse rose from 100 to 130 during that time.

A soft rubber catheter was put into the bladder through the urethra for constant drainage. During the second night, the patient, who was on the verge of delirium tremens, got out of

bed and walked down the corridor, after pulling out the catheter. After this the patient was allowed to urinate every four hours or oftener. The wound became infected deep in the pelvis, and on the seventh day the bladder wound began to leak a little. This was probably owing to the fact that the patient had been allowed to go eight hours without urinating. He left the hospital in four weeks perfectly well.

The principal symptoms in both cases were: (1) Sudden severe pain in the lower part of the abdomen which remained as a constant pain; (2) Constant desire to urinate, with inability to do so; (3) A preference for erect or partially erect position of the body rather than the recumbent; (4) General tenderness, but little or no rigidity. (The abdominal wall was so lax in both cases that it bulged with the pressure of the free fluid in the abdomen.) (5) A small quantity of bloody urine in the bladder; (6) Dulness in the flanks.

As an aid to diagnosis, I cannot recommend Walsham's method of injecting air into the bladder. His own description of the method as applied to his second case seems sufficient to condemn it. His patient suffered intense abdominal pain and became collapsed; the heart became turbulent and respiration labored. Is this not a good deal for a patient already suffering from more or less shock to bear?

The boracic test, as I have stated previously, I believe to be one of the causes of general peritonitis in these cases, and therefore I think it ought to be used only in cases in which it is a positive necessity, and then only when the patient is prepared for immediate operation.

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- ⁴ ANNALS OF SURGERY, 1893, Vol. xvii.
- ⁵ ANNALS OF SURGERY, August, 1901, p. 209.
- ⁶ British Medical Journal, 1901, Vol. ii, p. 1772.
- ⁷ Case I in the report.
- ⁸ New York Medical Record, 1895, Vol. xlvii, p. 282.
- ⁹ Journal of the American Medical Association, July 28, 1888.

TABLE OF CASES OF SUTURE OF INTRAPERITONEAL RUPTURES OF THE BLADDER.
(Supplementary to Alexander's Table in the ANNALS OF SURGERY, August, 1901, p. 209.)

No.	Reference.	Surgeon.	Age.	Cause.	Date after Injury.	Condition of Peritoneum.	Size and Condition of Rent in Bladder.	Kind of Suture Employed.	Treatment of Peritoneum.	Incision in Peritoneum.	Catheter in Bladder.	Remarks.	Result.
1	Journal of American Medical Association, July 28, 1888.	Grant.	19	Run over by cart.	5 hours.	No peritonitis.	2½ inches long on posterior wall.	11 carbonized silk Lembert sutures.	Washed out with Thiersch's solution; drained by rubber tube.	No.	Catheterized every 2 hours.	Set up on fourth day.	Recovery.
2	ANNALS OF SURGERY, 1895, Vol. xxii, page 796.	Briddon.	48	Denies injury or drunk-ennes.	3 days.	No peritonitis.	Oblique wound in posterior wall 1½ inches long.	9 catgut sutures.	Washed out with hot water; drained by glass tube.	No.	Yes.	.....	Died in 24 hours.
3	ANNALS OF SURGERY, 1895, Vol. xxii, page 796.	Briddon.	21	Run over while drunk.	8½ hours.	No peritonitis.	Vertical wound of 2 inches; ragged edges.	13 fine sutures.	Perine flushed; drained by glass tube.	Yes.	Through perineum.	.....	Died in 4 days.
4	ANNALS OF SURGERY, 1895, Vol. xxii, page 796.	Briddon.	19	Cake of ice fell on him.	12½ hours.	No peritonitis.	2½ inches long on posterior wall; ragged edges.	Silk sutures.	Flushed with hot water; drained.	No.	Suprapubic drainage.	.....	Died in 12 hours.
5	Deutsches Zeitschrift für Chirurgie, July, 1901, Vol. lx, Nos. 3 and 4.	Dohm.	41	Run over by wagon.	48 hours.	No peritonitis.	4 centimetres long, almost transverse; irregular edges.	Mucous and coats with catgut; peritoneum with silk.	Drained with gauze.	No.	Nélaton's catheter in bladder.	Left hospital in 3 weeks.	Recovery. ∞
6	New York Medical Record, March 22, 1902.	Pedersen.	42	Fell out of window while drunk.	9 hours.	No peritonitis.	Transverse rent just within the peritoneal fold.	Continuous suture of partially chromicized catgut.	Peritoneal cavity carefully wiped out; gauze drain.	Yes.	Through perineal wound.	Leaking on second day.	Recovery.
7	ANNALS OF SURGERY, October, 1902.	Blake.	34	.....	12 hours.	No peritonitis.	Rent of three inches posterior wall.	Catgut sutures.	Flushed with salt solution and sponged out.	Yes.	Through perineal wound for 7 days.	No additional drainage.	Recovery.
8	.....	Jones.	27	Ran into post.	89 hours.	Intestines dark red; one coil in posterior cut-de-sac roughened.	2½ inches long in posterior wall; vertical edges thickened.	Lembert sutures of silk, two layers.	Flushed with hot salt solution; gauze drain.	No.	Constant drainage for 6 hours, then voluntary micturition.	No leakage.	Recovery.
9	.....	Jones.	26	Refused to admit any injury or drunk-ennes.	18 hours.	No peritonitis.	Wound high on posterior wall, 1½ inches long.	Lembert sutures of fine silk, in two layers.	Flushed with salt solution; gauze drain.	No.	Constant drainage for 48 hours.	Voluntary micturition after 48 hours; leaking on seventh day.	Recovery.

A CASE OF PANCREATIC CYST, WITH REMARKS ON THE PATHOLOGY AND SURGICAL TREATMENT.

BY CHARLES GREENE CUMSTON, M.D.,

OF BOSTON, MASS.

As the surgery of the pancreas is still young, the report of the following case of cyst of this organ may not be devoid of interest.

The patient, a young woman twenty-six years of age, was accidentally struck by a chair in the region of the stomach. At the time the injury was received the patient lost consciousness and was removed to her apartments. A stimulating treatment was prescribed by the physician summoned, and the patient shortly recovered, only to complain of more or less pain in the upper abdomen for several days.

Within a week from the time of the accident, the patient was able to travel, and continued to do so for about three months. During this time she occasionally complained of colicky pains in the abdomen, but in other respects appeared to be perfectly well. In July, 1900, that is to say about five months after the injury was received, she was suddenly awakened in the middle of the night by a sharp pain in the right hypochondriac region, which continued off and on for several days, and finally disappeared. During this attack there was no jaundice, and, as far as could be ascertained, the stools remained normal in color.

The patient remained quite well after this attack until the early part of September, when she was again suddenly stricken with very severe colicky pains in the region of the liver. This attack occurred during the night, but by morning her condition was improved. For the next fortnight the patient felt perfectly well, but again the pains appeared, although they were not quite so severe, and appeared to be rather more in the region of the stomach. On this occasion there was slight jaundice present, and the stools bordered on the clay color. The patient was beginning

to feel somewhat exhausted from these repeated attacks of pain, and began to suffer from vague digestive disturbances, more particularly a fulness in the stomach after eating, and the more or less distention of the bowels from gas, an hour and a half or two hours after eating.

The condition continued pretty much the same until another attack of colic occurred in the early part of October, and as gall-stones were suspected, the patient was advised to seek surgical advice.

Examination of the patient on October 6, 1900, revealed the following conditions: A tall, well-built, and fairly nourished woman, presenting a slight suggestion of jaundice. The skin and mucous membranes are rather dry. Tongue coated with a thick white fur. Temperature, normal; pulse, 82; respiration, 19. Examination of the thoracic contents was negative.

By inspection, the upper part of the abdominal walls seemed to bulge slightly forward, and it appeared that the hepatic region was fuller than the left hypochondrium. By palpation the region of the liver and the epigastrium was quite tender. Liver dulness extended from the mammary line to five fingers' breadth below the costal border, and extended horizontally backward through the middle line slightly below the umbilicus. The surface of the liver appeared to be somewhat irregular, while pressure under the margin of the organ provoked some pain, more particularly towards the epigastric region, at which point it became very sharp, and was at its maximum at a point midway between the xiphoid cartilage and the umbilicus.

From the tympany present by percussion, I was under the impression that the colon covered the liver and was probably adherent to it. It also seemed as if the contours of the stomach were more to the left than was to be expected normally. There was no apparent dilatation of the organ.

The lower half of the abdomen appeared normal, and bimanual examination of the genital organs was negative. Urine was normal, and at the time of the examination the stools were very light brown in color, and could only be obtained by the daily use of laxatives.

The result of this examination, as may be seen, left one in considerable uncertainty as to the true nature of the affection; but my impressison was that we were dealing with an enlarged

gall-bladder, and suggested an exploratory incision as the best course to be pursued.

Two days later the abdomen was opened in the median line from the tip of the sternum to the umbilicus. The stomach was found in its normal condition, protruding from under a normal liver and pushed forward by a cystic mass situated behind the viscus. By palpation the tumor appeared to be the size of a large grape fruit, and fluctuation was distinctly present. The gastro-colic ligament was torn through and the tumor exposed. It was more or less adherent to the surrounding structures. Careful examination showed that it would be imprudent to loosen the tumor by breaking down the adhesions, so I decided to stitch the upper pole of the cyst to the peritoneum of the anterior abdominal wall. This was accomplished with some little difficulty, but it was finally secured firmly in position by catgut sutures. The remaining part of the abdominal incision was then closed. The cyst wall was then incised, and about 700 or 800 centimetres of dirty greasy fluid, containing fat corpuscles in considerable amount, was evacuated. The interior of the cyst was then explored by the finger. As a whole, it felt more or less soft and even, although in some spots patches of granular-like tissue were found. A large glass drainage tube was then inserted and the cyst carefully packed with iodoform gauze.

Three hours after the operation I was hurriedly summoned by the nurse, who stated that a postoperative hæmorrhage had taken place, and on my arrival I found the abdominal dressings thoroughly soaked with dark blood. The dressings were removed as well as the drain and the iodoform gauze filling the cyst, and it was then found that a general venous oozing of considerable intensity was taking place from the lining membrane of the cyst. The cavity was freely irrigated with a hot salt solution, and was then carefully packed with gauze cravattes, which were saturated with a 10 per cent. solution of gelatin. This permanently controlled the bleeding.

For the first two weeks following the operation the cyst secreted a large amount of a dark yellow fluid containing small masses of necrotic fat, to such an extent that the dressings were changed several times a day: the opening showed no signs of granulation tissue until about the tenth day, and then it began to contract.

By the end of the third week following the operation the secretion began to diminish in quantity. It became thinner in consistency, while in color it bordered on a light yellow. The circumference of the opening gradually diminished, so that five months after the operation only a small fistulous tract remained, which was definitely closed in about five weeks by injections of chloride of zinc.

The patient was seen in August, 1902, and found to be in a perfect condition of health. The abdominal wound was perfect, there being no trace of hernia in the region of the fistula, and by palpation only a slight amount of thickening could be felt by deep pressure, which was painless to the patient.

The contributions to the pathology of pancreatic cysts have not been numerous, but I think we may safely divide these pathologic productions, as does Körte, into four groups. (1) Retention cysts of the excretory duct; (2) proliferation cysts of the pancreatic tissue (cystadenoma); (3) retention cysts originating from the glandular vesicles, and the smaller excretory ducts due to narrowing, which is the result of a chronic interstitial pancreatitis; (4) pseudocysts, which are cystic formations arising from inflammatory or traumatic lesions of the pancreas, and which give rise to retroperitoneal hæmorrhages or to a collection of blood in the bursa omentalis.

In the first group the retention cysts are either present in the form of ampullary dilatations of the entire principal excretory duct, and which may extend into the neighboring canals, or there may be circumscribed sacculated dilatations. A third type has been described by Klebs which originates in the smaller excretory ducts or even within the alveoli, and which he terms *acne pancreatica*. These formations are more often found in clusters in certain spots of the gland, the larger ones, which are often multilocular, being formed by the fusing together of the smaller cystic productions.

Formerly it was generally believed that all retention cysts were either formed by an obstruction of the excretory duct by certain pathologic concretions, by a cicatricial contraction which was the end result of a catarrhal swelling of the duodenal open-

ing of the duct, or to its obstruction by the presence of neoplasms, etc.

Recent investigations have demonstrated that there are certainly other etiological factors in the formation of these cysts, and our illustrious compatriot Senn was one of the first to forcibly oppose the older theories. His experiments on animals seem to have conclusively proven that after ligation of the duct of Wirsung no cystic formation arises, and, what is still more striking, there is scarcely any noticeable dilatation of the canal. That this dilatation only attains a moderate degree is explained by the fact that the pancreatic secretions are resorbed by the lymphatics and blood-vessels as soon as the pressure reaches a certain degree. The secretions form only for a short time, because the involved glandular parenchyma being separated from the rest of the organ is soon destroyed by fatty degeneration and proliferation of interstitial connective tissue.

Experimentally, the ligation of, or pathologically the obstruction of, the excretory duct is quite insufficient for the production of a retention cyst, and Heinricus has pointed out that the most important etiological factor in the production of pancreatic cysts is the prevention of absorption of the pancreatic juice by the admixture of non-absorbable pathologic substances, or by a diminished functional activity of the vessels whose work it is to accomplish absorption.

But, as a matter of fact, the large majority of retention cysts attain only a very small size, and are of more interest to the pathologist than to the practical surgeon, as they only exceptionally produce serious trouble, and are most always met with as surprises during a necropsy.

The second type of cyst—the so-called proliferation cyst—is in reality a neoformation, which can be compared to ovarian cysts and similar pathologic products. So far as I have been able to ascertain, only fifteen instances of cystadenomata have been recorded. Körte says that they were cystic productions covered by a cylindrical epithelium, which by its proliferation had formed partly glandular formations and partly polypoid

productions, which were covered with epithelium. Waldeyer says that a progressive neoformation of glandular spaces takes place in the walls of glandular cystomata, and which change into cysts containing a mucoserous fluid. By slow development the walls of the cysts become thin and finally give way, and thus the cysts merge into one another and increase in size. At a later period the growth of the cystic cavities continues to increase on account of the fluid and mucous or colloid degeneration of cells desquamated from the lining wall of the cyst. This is simply a secondary development in the pathological process. What characterizes a proliferating cystic formation is the slow growth and the complete absence of any inflammatory process which could give an impulse to the growth.

Beside the retention cysts above mentioned, others are found which apparently bear no relation to the excretory ducts. They are larger in size, and usually arise from the tail of the pancreas, their contents being in most instances a blood-tinged liquid. The fact that the contents has shown signs of the presence of blood was considered most important for the understanding of the origin of this type of cyst. Le Dentu and Friedreich affirm that cysts arising in the pancreatic tissue have hæmorrhage as a primary etiological factor. The latter mentioned authority states that most hæmorrhagic processes are due to a passive hyperæmia, which is frequently combined with a chronic interstitial inflammatory process present at the same time in the parenchyma of the pancreas, and produced by the same etiological conditions. The hæmorrhagic exudates infiltrate the proliferating interstitial tissue, and later on in the process cystic formations become evident. These apoplectic cysts must be distinguished both in their nature and origin from cysts containing blood, and which are produced by hæmorrhages taking place into the cavity of a pre-existing retention cyst.

The above pathology has been accepted until quite recently, until the writings of Tilger and Körte appeared. These authorities look upon the apoplectic genesis of pancreatic cysts in an entirely different manner; and the former authority puts

forth the view that these cysts are produced by an entirely different cause, and that the hæmorrhages are only secondary occurrences in the process, and occur directly within the cyst cavity.

Tilger appears to have proven quite conclusively from his own researches, and that of other authorities, that an interstitial pancreatitis is present; and he ascribes the chief rôle in the formation of these cysts to the chronic interstitial inflammation and the proliferation of connective tissue arising around the lobuli. The constriction of the smaller vesicles of the gland produces an obstruction of the secretion, and with the resulting degeneration of the epithelium microscopical cysts arise. The same authority believes that the larger cysts arise from the smaller ones on account of the digestive powers of the pancreatic juice, while Dickhoff believes that the larger cysts are formed from the contraction of the proliferating connective tissue, and the obstruction to the secretion which produces a disappearance of the septa dividing the cystic cavities.

Tilger supports his view from the fact that the peptonizing fibrin digestive ferment is absent, and consequently must have been used up. In reply to the objection that in cysts of long standing no enzymes are present, he opposes the results of the latest investigations which have proven the presence of active ferments in retention cysts of long standing. Why in some cases the ferments have a solvent action and in others none, is as yet an unsolved problem. Boellke thinks that Tilger is too absolute regarding the absence of the ferment and its destructive action. At the present time all that can be said is that in some cases the digestive fibrin ferment is wanting, while in others the emulsifying or starch digesting ferment is absent.

Chronic interstitial pancreatitis is the result of traumatic affections or various forms of irritation coming from the intestinal canal. Chronic catarrhal inflammation of the stomach, obstruction in the portal circulation, or of the duct of Wirsung from catarrhal inflammation or sediments, tumors, etc., are liable to produce an irritation of the pancreatic parenchyma which later on induces a proliferation of the connective tissue,

and finally cystic formation results, as has been above described. It is also quite possible that inflammatory lesions of the pancreas may be caused in just the same manner as when they arise from intestinal irritation by traumatism to the upper part of the abdomen, and, according to Tilger's theory, the development of connective tissue and stricture of the vesicles of the pancreatic parenchyma may also lead to cystic formation in the latter case.

If this etiological factor of the development of the pancreatic cysts is an infrequent one, there are nevertheless a number of cases reported in the literature which make such a supposition more than probable, but I will not deal with them at the present time.

Besides the above mentioned types, other cases have been reported in which a cyst has developed following a severe contusion of the upper part of the abdomen, such as in the case here detailed. They have usually been found to contain a blood-stained or a transparent thin mucus, and frequently pancreatic ferments have been shown to be present, demonstrating that there was a direct communication with the pancreatic tissue. It would seem, however, that these tumors, which were considered as pancreatic cysts, were not so in reality, and simply were the result of hæmorrhages which had arisen in the subperitoneal aspect in the posterior surface of the omentum or in the bursa omentalis itself, and sometimes really extended into the pancreatic parenchyma.

The formation of subperitoneal pseudocysts occurs after a contusion of the epigastrium; there results a collection of blood and pancreatic secretion between the gland and the peritoneum covering it. As the collection increases, it pushes the peritoneum forward and protrudes into the bursa omentalis. As a secondary event, the extravasation may rupture into the omentum, or, on the other hand, the peritoneum remains intact, and is finally pushed forward until it reaches the gastrocolic ligament. The cyst thus pushes itself more and more between the stomach and transverse colon, and finally reaches the anterior abdominal wall.

Now, if the contusion produces not only a rupture of the glandular parenchyma, but also of the visceral peritoneum, a hæmorrhage occurs into the bursa omentalis, and the result is that the hæmorrhagic fluid is mixed with the pancreatic juice, and there results a circumscribed peritonitis with adhesions in the foramen of Winslow, which obstructs the latter, and thus a cyst is formed between the stomach and the transverse colon.

Although these two types of pseudocysts show a great difference in their anatomical positions, it is often impossible after a time to differentiate one from the other and to discover the exact starting-point, because the adhesions with the neighboring structures are very extensive.

Pseudocysts are in most instances characterized by a rapid growth, which is easily explained if one takes into consideration their mode of formation.

It would be well to mention here that Fischer believes that pseudocysts of the pancreas are in many cases hæmorrhagic exudates arising between the folds of the transverse mesocolon, and only become connected with the pancreas secondarily. According to the position of the swelling, the tumor will either lie above or just posteriorly to the transverse colon; but I would point out that these cysts are to be strictly differentiated anatomically from true pancreatic cysts, although they give rise to the same clinical phenomena, and are dealt with in quite the same manner as in other cystic formations.

In truth, very little is known about the etiology of pancreatic cysts. We often get a history of trauma in the upper region of the abdomen, and we can undoubtedly accept this as the causative factor in exudations arising in the bursa omentalis, the so-called pseudocysts, which appear within a short delay after a traumatism has been received. Perchance, also, if Friedreich's theory be accepted, a true cyst of the pancreas may be occasionally produced by a traumatic hæmorrhage arising in the pancreatic parenchyma. Owing to the frequent exposure that males undergo to traumatism, the larger majority of the cases of traumatic pancreatic cysts has been found in men. In many instances a gastro-enteritis preceded the advent of the

tumor. The patients first complained of dyspepsia, colics, and vomiting; but it must be remembered that the cause and the results should not be confounded. A slowly developing cyst might very possibly give rise to disturbances of the circulation and of digestion.

In other cases the history of the disease has shown that the patients had suffered from some acute infectious malady, and it is well known that after acute infections chronic changes arise in glandular organs; and it is quite possible that certain pancreatic cysts may be etiologically related to the acute infections. In quite a number of instances no cause could be attributed to the development of the tumor, the patients having always been in good health; and Körte found that the majority of these cases occurred in the female, although he could give no good reason for this fact.

As far as the treatment of cysts of the pancreas is concerned, surgical interference is the only one. The operative methods are two in number, namely, incision and drainage, or total extirpation.

The choice of the position of the incision should be guided entirely by the location of the growth, but in most of the cases reported the abdomen was opened in the middle line, occasionally over the most prominent part of the swelling.

If, after separation of the gastrocolic ligament and the peritoneum covering the cyst, the growth is found to lie freely, or if the existing adhesions can be easily separated, and the growth pedunculated, total extirpation is naturally the proper course to pursue. If the contrary conditions exist, the only choice that is left to the surgeon is incision and drainage.

After the cyst has been freely exposed, it should be stitched either to the abdominal wall or to the peritoneum. It appears to me of very little importance whether or not part of the contents is removed by an aspirator, because, if the abdominal cavity is properly walled off by gauze, there is little fear that it will become contaminated should any of the fluid contents of the cyst escape while the sutures are being inserted.

It would appear more advisable to stitch the parietal peri-

toneum to the peritoneum covering the cyst, and then the walls of the cyst may or may not be sutured to the borders of the abdominal incision. When the cyst has been anchored, it should be incised, and then the borders of the incision may or may not be sutured to the skin. A large glass drainage tube should be inserted into the cyst and its cavity packed with gauze.

Some surgeons have done the operation in two sittings. In the first they stitched the cyst to the parietal peritoneum, and then partially closed the abdominal wound, the remainder of which was left open and packed with iodoform gauze. In a few days firm adhesions have been formed between the cyst and the abdominal wall, so that when the latter is incised the contents cannot escape within the abdomen.

As to the ultimate results of surgical treatment of these cysts very little has been as yet recorded. Naturally, in those cases where total extirpation of the growth has been possible, there is probably only very little chance that a recurrence of the affection may take place. Of course, it should be remembered that it is quite possible that another cyst may develop at a later date, and which might arise from portions of the gland which had undergone cystic degeneration, and naturally at the time of the operation these changes would be overlooked.

In cases treated by stitching the cyst to the abdominal walls and drainage, it would seem that there is a great possibility of recurrence; and it should also be borne in mind that interminable fistulae may result, which often give rise to various complications. It should be considered as a very fortunate occurrence that a closure of the fistula was obtained in the case here reported; and it is to be hoped that it will remain closed, as it probably will, if one considers the length of time that has passed without it showing any evidence of opening.

In reported cases of incision and drainage, the progress of the recovery has usually been that the secretion from the cyst is first increased and then diminishes; a fistula then results, which contracts more and more until it finally closes up. But, as has been pointed out, the fistula will not always close; and

in one case reported by Gould a fistula was present three years after the operation, while in another recorded by Gravemann the cyst was discharging after the lapse of over a year after the operation, and showed no tendency to close at that time.

Regarding total extirpation of pancreatic cysts when the operation is feasible, it theoretically would seem a most radical operation, and liable to do away with all further trouble; but it should be remembered that the operation is not devoid of danger. Firstly, on account of the deep situation of the pancreas, the control of hæmorrhage is a most difficult matter; and, secondly, important organs may easily be damaged if great care be not taken. If complete extirpation is attempted, it is better to first dissect the tumor from the peritoneal covering and then to continue the dissection from the pancreas, and after the growth has been removed completely, and when all hæmorrhage has been controlled, the abdominal cavity may be closed.

If in attempting a total extirpation of the cyst the adhesions are found tougher than was at first supposed, or a severe hæmorrhage or oozing results, it would seem better practice to desist from the removal of the cyst and simply stitch it to the abdominal wall and drain.

THE QUESTION OF SURGICAL INTERVENTION IN CASES OF INJURIES TO THE SPINE.¹

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THERE has been much doubt in the minds of surgeons regarding the proper course to pursue in treating persons who have been so unfortunate as to have had fractures or dislocations of the vertebræ. The first formal operation to remove a depressed spinal arch was made in 1814 by the younger Cline. In writing of his operation Cline said, "The only reasonable objection to the operation of trephining the spine is that we cannot, previous to the operation, ascertain whether the spinal cord be simply compressed, or whether it be partially or entirely torn through, or whether the symptoms of compression result from effusion of blood in different situations, neither of which, indeed, can be ascertained after the vertebral canal has been opened, unless the sheath be rent." It seems somewhat remarkable that after the lapse of nearly one hundred years the same statement will about express the doctrine promulgated at the present time. Two conclusions are possible,—either the surgery of the spine has not advanced in proportion to the strides in other fields, or the knowledge relating to the spinal cord has not yet sufficiently developed to give the correct indications for treatment.

At the present time the opinions of surgeons are divided into three groups: First, those who advocate exploration in every case of injury to the spine in which symptoms on the part of the nervous system are present; second, those who advocate total abstinence from operative measures; and, third, those who occupy the middle position and advocate operation

¹ Read before the Academy of Medicine of Cincinnati, November 18, 1901.

only in selected cases. These three groups will include the names of the prominent surgeons of the world to-day and correctly express their opinions. It is not possible for all three of these opinions to be correct, but it by no means follows that any one of them is absolutely wrong.

Injuries to the spine, like traumatisms to the skull, derive their chief importance from the damage done the contained nervous structures. Were it not for these effects upon the nervous tissues, injuries to both the skull and spine might be classed among the more trivial accidents. We can, therefore, at the outset practically exclude the osseous structures from consideration, because it must indeed be very unusual to have so extensive an injury to the bony parts as to require surgical intervention for the correction of deformity or for any other condition connected directly with the bone. The question of intervention, then, depends very largely, if not entirely, upon the amount of injury done to the spinal cord and upon our ability to annul or correct the baneful effects of such injury.

In the present state of our knowledge of surgical therapeutics and of the reparative powers of nature, it may safely be assumed that surgery offers no hope of improvement in the cases in which a complete transverse destruction of the spinal cord has taken place. Weissman's dictum that "Nerve-cells once destroyed are never replaced" may be accepted as proved, although some observations, notably those of Worcester, seem to prove the contrary. Lewellyn Barker ("The Nervous System," p. 246) says, "Regeneration of severed nerve-fibres within the spinal cord and brain is unfortunately very much less complete than in the peripheral regions."

All records obtained from operations and necropsies indicate that a complete transverse destruction of the cord is followed by permanent paralysis. Sufficient regeneration of nervous tissue to carry on the functions of the spinal cord does not occur, and no method is at present known by which these functions may be restored. In all cases of injuries to the spine involving the cord, the first and all-important question must be, Does the case present symptoms which lead the surgeon to

believe that nervous impulses can still be transmitted, wholly or in part, through the damaged area of the cord? Every surgeon will admit that operation in cases of complete transverse destruction of the cord is not only unscientific, but must be absolutely useless. When such a condition can be diagnosed, operative measures should be tabooed, because operation can give no relief to the patient, while it may bring reproach upon surgery.

A necessary preliminary to the above question is, Can an accurate diagnosis of complete transverse destruction of the cord be made? As so much depends upon the answer to this question, it is advisable to consider it in some detail.

It may be assumed for all practical purposes that nervous symptoms may be the result of three possible conditions of the spinal cord,—concussion, compression, or destruction. A proper discrimination in the diagnosis of these conditions seems to be the key to the whole question, because, where the symptoms are due to concussion or compression, restoration of function is possible either through waiting or through surgical measures.

Concussion of the spinal cord is, like the similarly named condition of the brain, largely a speculative one. It is applied, in all probability, to those cases in which there is comparatively little or no actual injury to the nervous tissue of the cord; in other words, those conditions in which nature promptly restores the function. As these cases all recover without operation, there is no data from which one can ascertain the pathological condition. Assuming such a condition to actually exist, surgical intervention is not at all necessary, because these cases all recover unaided.

Compression may be due to either extravasated blood or direct pressure from bony fragments. When due to extravasated blood, the probability of spontaneous restitution of function is much better than when due to bony compression.

The records of the Cincinnati Hospital contain the notes of twenty-four necropsies on cases of spinal injuries. In but four is mention made of any considerable amount of blood

within the vertebral canal, and in all of these more serious lesions were present. Thorburn ("A Contribution to the Surgery of the Spinal Cord") records but three cases out of fifty-six detailed, in which any considerable hæmorrhage is noted. We may therefore assume that compression from extravasated blood is not a very frequent condition, or that its symptoms are very evanescent.

From the stand-point of prognosis much stress must be laid upon gradually increasing, slowly appearing nervous symptoms following a spinal injury. Theoretically, cases of compression due only to pressure of extravasated blood should not be subjected to operative measures, because absorption of the clot will be followed by restoration of function. Compression by bony fragments or fibrous tissue and destructive lesions alone remain to be considered.

The following case report is a beautiful illustration of the value of surgical intervention in cases of compression by bony fragments. It is more fully reported in the *Cincinnati Lancet-Clinic*, December 25, 1897.

CASE I.—L. S., aged thirty-six years, attempted to mount a moving train, June 19, 1897, but lost his balance and fell between the platform of the station and the trucks of the engine. The oil-box of the engine struck him in the back. His head was also injured. He became unconscious immediately. When examined at his home by two physicians, it was ascertained that he had sustained a fracture of the sternum at the junction of the manubrium and gladiolus; that he had some superficial scalp wounds, and that he was badly bruised about the junction of the dorsal and lumbar regions. A fracture existed at this point.

The statement received from his physicians was that complete motor paralysis of the lower extremities and rectal and vesical paralysis supervened immediately after the receipt of the injury. During the following two weeks he suffered from almost constant priapism. He was admitted to the Presbyterian Hospital on July 13, 1897.

The writer saw the case with Dr. S. E. Allen on July 14. The notes made at this time say, "There is swelling at the dorso-lumbar articulation due to the displacement of the first lumbar

vertebra to the right. Motion is absent below the hips. The patient cannot flex or extend the hip, knee, ankle, or toes. The abdominal muscles can be contracted at will. All movements of the upper extremities are unimpaired. He cannot turn in bed except when aided by his arms. By means of this aid he can turn promptly to either side. Turning to the right side causes pain in the dorso-lumbar articulation, but no pain is experienced when the patient turns towards the left. The gluteal muscles and all those in the leg below these are completely paralyzed so far as motor power is concerned. The senses of tact, pain, heat, and cold are present in all parts, and responses are quickly obtained. There is no tenderness on compression of the leg or thigh muscles. There is some defect in the muscle sense impressions in the toes. The rectal reflex is absent and there is incontinence of fæces. Micturition is not impaired. The jaw-jerk is absent, as is also the knee-jerk on both sides. Triceps and wrist-jerks are present. The epigastric, abdominal, and plantar reflexes are present. No bed-sores are present. There is marked atrophy of all the muscles of both legs and no faradic reaction."

Exploration revealed a fracture of the first lumbar vertebra, with twisting of the first and second lumbar vertebræ to the right side. Fragments of bone were found pressing upon the cord, particularly upon the left side. One fragment had been driven alongside the left side of the cord and was evidently compressing the nerve-roots. Fragments of bone were carefully removed from every point of impingement upon the nerve structures. The dura was not opened as the cord seemed to be sound.

The patient made a very rapid recovery and was able to walk home, November 18, 1897. He can at the present time walk without any limp or peculiarity sufficient to attract attention and is actively engaged in business.

Particular attention is directed to the fact that pressure sufficient to cause complete motor paralysis existed thirty-five days before its relief by operation, and yet motion of the toes and ankles began a week after operation and complete restoration of function ultimately occurred. It should also be noted that the injury in this case was the result of direct violence.

For the purpose of comparison, I desire at this point to introduce short histories of two other cases in which rhachiotomy was done without any relief of the symptoms.

CASE II.—This case was reported to the Ohio State Medical Society at Zanesville on May 17, 1894. The full report will be found in the *Transactions of the Ohio State Society* for 1894, on page 186. A short report of the case is here given.

The patient was a farmer, aged thirty-four years, American born. Was first seen by me September 19, 1893. Fourteen months previously the patient fell from a tree, a distance of about twenty feet. He struck between his shoulders, head foremost, and the body then twisted violently towards the right side. Consciousness was not lost, but an immediate paraplegia supervened. Within two days a bed-sore appeared over the sacrum, which persisted for eight months. Paralysis involved both the bladder and rectum. Pain and soreness from the immediate injury gradually passed away, leaving behind a motor and sensory paraplegia, incontinence of urine, and rectal incapacity. The reflexes were all present and exaggerated. The legs were not particularly atrophied, neither were they contracted. There was no reaction to either faradic or galvanic electricity. The general condition was excellent, he being well nourished and of good color. He was able by means of a bar to raise himself from his bed into a rolling-chair and then to propel himself with ease. The girdle sensation was not well defined, though there was a suggestion of one present. Examination of the back showed a projection over the region of the eighth and ninth dorsal vertebræ. The patient was advised to have the parts explored. At the same time he was informed that the probabilities were strong against his receiving any benefit from the operation.

The operation was made on September 28, 1893. It was found that the seventh dorsal vertebra had been displaced, being turned to the right. The eighth and ninth had probably been fractured, and the spinal cord had been caught between the dislocated seventh and fractured eighth, thus producing an apparent disorganization of the cord for the space of about one inch. The dura mater was adherent to the bony canal. These adhesions were separated and the dura opened, when it was found that the structures of the cord seemed to be absent from the pinched portion except for a very narrow strand of nervous tissue.

On November 3 he returned to his home, the paraplegia being unchanged. The urinary symptoms were about as before, but he declared that the bowels moved more easily and satisfactorily than at any time since the accident.

The injury in this case had occurred fourteen months previous to operation, but the symptoms had remained unchanged from the moment of the accident to the date of operation. Although the patient is still alive, the condition remains the same as it was when he left for his home.

CASE III.—*Fracture of the Cervical Spine; Motor and Sensory Paralysis; Rhachiotomy; Death.* (Reported in *Cincinnati Lancet-Clinic*, December 25, 1897.)

A. W., aged sixty-two years, laborer, married. Patient was an old alcoholic, otherwise history was negative. On September 19, 1897, while under the influence of liquor, the patient probably fell down stairs, or at least he was found at the bottom of some steps, he having no knowledge of how he got there. He was unconscious for a short time. Dr. W. E. Shaw saw the case at the home of the patient. I saw the case with Dr. Shaw on the 20th, and found the following conditions present: Patient conscious and mental condition bright. Pulse was fairly good in volume but slow, being about 56. Respirations were rather stertorous. Temperature was subnormal. There was complete motor and sensory paralysis from the third rib down on the right side. On the left side the paralysis was complete in the arm as well as in the parts below. On the right side there was paralysis of the extensor muscles, the patient being able to flex the arm, but not being able to straighten it out after it was flexed. The pupils were contracted. There were no open wounds at any place. The bladder and rectum were paralyzed. The sense of heat and cold was abolished, as was also the muscular sense. Superficial reflexes were not present. Respiration was largely diaphragmatic. The patient was able to turn his head from side to side, and did not complain of pain when this was done. Examination of the head showed nothing abnormal. Examination of the neck posteriorly showed an irregularity at about the location of the second and third cervical vertebræ. Dr. Shaw had previously obtained crepitus at this point, so I made no attempt to elicit it. Diagnosis of fracture of one or more cervical vertebræ was easily made. The patient was sent to the Cincinnati Hospital, and entered my service in that institution.

On the following day, the 22d, the parts were explored under chloroform. Incision was made in the median line and the soft parts retracted. When this was done, fractures of the second

and third cervical vertebræ were made out. The loose pieces of bone were removed, the dura mater being laid bare. The dura mater was not opened, but the impression given by the sense of touch led us to believe that the cord at this level had been very largely disorganized. The patient rallied nicely from the operation, but when consciousness was regained the conditions were the same as previously recorded.

On the following day, the 23d, there was no change in his condition.

On the 26th it was noticed that a bed-sore was beginning over the sacrum. There had been a contusion of this part at the time of his accident. His mental condition remained good. The wound healed by first intention, but throughout there remained the conditions of paralysis above noted. The pupils remained contracted throughout the course of the case. Extensor paralysis of the right arm remained, also complete paralysis of the left arm and of all the parts below. The breathing became more and more diaphragmatic, and the patient gradually declined. Marked atrophy of the muscles was present and advanced rapidly.

He died on the 11th of October. Autopsy was not obtained because of a misunderstanding on the part of one of the officials.

From the stand-point of surgery, the question of intervention must be determined by the symptoms presented in each individual case. One may probably say with exactness that when all of the functions of the spinal cord are abolished in the area below the seat of the injury, the patient should not be submitted to operation. This statement may be qualified somewhat by saying that if, after the lapse of several days, there are no indications of nervous activity in the affected parts, one may safely assume that surgical measures will be of no avail in rectifying the condition.

Dr. A. J. McCosh, in the *Journal of the American Medical Association* of August 31, 1901, says, "As yet we have not sufficient experience or knowledge to make any definite statement concerning the early symptoms which indicate complete destruction of the cord. We do know, however, that if certain symptoms be allowed to persist for days or weeks the case will be hopeless. It is our duty to make an attempt to remove these

symptoms and their cause before it is too late. It has been stated more than once that where there is complete loss of sensation, motion, and patellar reflexes in both lower extremities, the symptoms indicate a complete crush of the cord, and that the case is absolutely hopeless. This view, however, is not correct, as has been shown by more than one case where all these symptoms have been present, and yet where, after removal of fragments of bone, recovery has resulted."

He then gives a history of a case of fracture of the seventh dorsal vertebra in which there was complete loss of sensation and motion, and abolition of the tendon, cremasteric, and abdominal reflexes. Operation was done nine hours after the injury and the patient recovered. Four or five bony fragments were removed. The dura was lacerated and the cord contused. There were small hæmorrhages present also. Improvement began five days after the operation and continued.

The only objection that can be urged to this case is that sufficient time had not elapsed after the injury to determine the permanence of the symptoms, so that this case does not by any means disprove the complex of symptoms which are usually considered diagnostic of a complete destruction of the cord.

Every surgeon must agree with Dr. McCosh in the statement he makes regarding our inability to diagnose the condition of the cord from any one or from any group of symptoms. Yet we must, of necessity, consider a case exhibiting complete paralysis of motion and sensation, absence of muscular and thermal senses with rectal and urinary paralysis and complete abolition of reflexes both superficial and deep, one in which the spinal cord gives no evidence of activity, and, so long as this picture persists, not one for operation. In the first case reported in this paper operation was advised because of the existence of the senses of tact, pain, heat, and cold along with ordinary sensation. These symptoms undoubtedly proved that a portion at least of the spinal cord was capable of functioning. This being true, a complete transverse destruction could not have been present. The knee-jerks were absent in this case, and remained in abeyance for a considerable time after

operation. This seems to be at variance with the dictum of Bastian that "Permanent loss of reflexes indicates a complete transverse lesion of the cord."

Kausch (*Deutsche medicinische Wochenschrift*, March 14, 1901) reports a case in which laminectomy was done upon a young woman for a tuberculous affection of the vertebræ. The spinal cord was completely divided transversely at the sixth and the eighth dorsal vertebræ. The tendon reflexes and muscle tonus were at once completely abolished, but returned,—the former in twenty-four hours and the latter in forty-eight hours. These persisted afterwards unmodified. The patient lived five and a half months. It would seem, therefore, that we have not yet arrived at the point in spinal diagnosis where a complete transverse destruction can be accurately predicted. Nevertheless, it would seem to be a good plan for surgeons to avoid operation in those cases which present an entire absence of spinal function, and to operate in any case in which evidence of impulses being transmitted through the damaged portion can be secured.

Another important point is the time at which operation should be performed. The usual advice given is to operate as soon as possible because of the possibility of prolonged pressure producing irreparable injury to the spinal cord. It would seem, however, that this fear of pressure effect is not well grounded. It is probable in the vast majority of cases that the pressure, if sufficient to cause destruction of the cord, produced its effect primarily, and the secondary degenerations were the result of extension of the spinal condition rather than due to continuous pressure. Carl Lauenstein (*Centralblatt für Chirurgie*, No. 51, 1886) records a case in which an excellent result was obtained by operation, even though paraplegia, rectal and urinary symptoms and atrophic changes had been present, and in which the injury preceded the operation by five weeks. Dr. McCosh records a still more convincing case in the article above referred to. His case, No. 6, was an old fracture of the fourth cervical vertebra, in which paralysis had been present for eight months, and yet complete recovery occurred. In his account of the

operation he says, "The fourth lamina had evidently been fractured and exerted posteriorly considerable pressure on the cord. In addition to this a new layer of connective tissue, with a much thickened dura, was found." In the first case reported in this paper the spinal symptoms had remained unchanged for thirty-five days before operation was undertaken, and yet recovery was complete. S. H. Weeks (*Transactions of the American Surgical Association*, 1901) quotes a case reported by Huss in which perfect recovery followed operation done a month after injury. Paraplegia, paralysis of the rectum and bladder, and a bed-sore over the sacrum are given as the symptoms present during the month. M. Allen Starr (also quoted by Weeks) reported a case in which the cauda equina was compressed for a year. Recovery, except for anæsthesia, followed operation at the end of the year. Wyeth also reports a case of a man with a fractured second lumbar vertebra operated on two years after the injury. Great improvement followed the operation, said improvement beginning six hours after operation. It would seem probable, therefore, that the question of the time that elapses between the date of injury and operation is not so important as it has previously been considered. In other words, if the injury is not irreparable at the time of accident, it is unusual for bony or other pressure to cause permanent abolition of function. This pressure may be sufficient, however, to hold the functions of the cord in abeyance. Dr. Samuel Lloyd (*Journal of the American Medical Association*, April 20, 1901, p. 1117) says, "In my opinion, therefore, we should wait until this period of shock has passed, and until it is evident that there will be no spontaneous recovery complete enough to render life bearable. If, after this period has passed, the patient still continues to improve, no operative interference should be considered, but as soon as the symptoms begin to show retrograde phenomena or seem to have reached the end of improvement operation should be undertaken."

The question as to what constitutes the proper waiting period is an important one for several reasons. In the first place, a large number of patients suffering from injuries of the

spine have other serious and perhaps fatal injuries; and, second, quite a number of cases will show disturbances of the spinal functions to a marked degree, and yet within a comparatively few hours exhibit pronounced improvement. It may be accepted as a rule that early operation is indicated in those cases in which there is evidence of some active function in the spinal cord. In the other cases, those in which there is no such evidence, it is highly probable that nothing is lost by waiting two or three days.

I have had copies of the histories of all the cases of this injury treated in the Cincinnati Hospital prepared. The comparatively large number of cases renders their study of particular value in deciding the future of cases of this kind without surgical intervention. The total number of cases presenting fractures or dislocations of the vertebræ is fifty-seven. Of these fifty exhibited symptoms arising from injury of the spinal cord, while seven failed to exhibit any symptoms of nervous involvement. The cervical region was implicated in twenty-three cases, the dorsal in eighteen, the lumbar in ten, the dorsolumbar in two, while in four cases the location of the injury is not specified. There were thirty-nine deaths among the fifty-seven cases (68 per cent.). Of the twenty-three cases in which the injury was located in the cervical region, twenty-two died, and one left the hospital on the second day following the injury, and his further history is unknown. Ten of the cases of injury in the dorsal region died ($55\frac{5}{9}$ per cent.). Five were discharged as improved, and three, in which there were no nervous symptoms, were discharged well. Out of the ten cases of injury in the lumbar region six died, one was discharged improved, and in three the condition was unchanged at the time of discharge. The two cases of dorsolumbar injury show a record of one death (50 per cent.) and one recovery, in which case no nervous symptoms were present. Of the four cases in which the locality of the injury is not given two died (50 per cent.) and two left the hospital alive, but no record was made as to their condition. Deducting the seven cases in which no evidence of involvement of the spinal cord was pres-

ent, there were fifty cases exhibiting spinal cord symptoms. Of these forty-one died (82 per cent.), four left the hospital unchanged so far as the nervous symptoms were concerned, and five were discharged as improved, but no account is given to indicate the amount or nature of the improvement. By putting the very best construction upon these figures, one can say that only 10 per cent. of the cases presented any improvement so far as the nervous lesions were concerned.

Eight of the fifty cases were operated upon. Six of these patients died (75 per cent.), and in two the condition remained the same as it was previous to the operation. Of the eight cases operated upon, the cervical region was affected in four and all died; the dorsal in two, one died and one remained unchanged; the lumbar region in two cases, one died and one was unchanged. The mortality, then, of operative cases in the cervical region was 100 per cent. The mortality of dorsal cases was 50 per cent., and that of the lumbar cases 50 per cent. None of the cases were benefited by operative intervention. Of the cases not operated upon, nineteen were in the cervical region. Of these eighteen died and one left the house the second day after the injury. The dorsal region was affected in eleven cases, eight of whom died and three showed more or less improvement. The dorsolumbar region presented two cases, with one death and one patient unchanged. The lumbar region presented nine cases, five of whom died, three were marked unchanged, and one was marked improved. The mortality, then, of cervical cases unoperated upon was $94\frac{14}{19}$ per cent., the dorsal cases $72\frac{9}{11}$ per cent., the lumbar $55\frac{5}{9}$ per cent., and the dorsolumbar 50 per cent. Comparing the mortality of the operated and non-operated cases, we find that the ratio is nearly the same in the cervical region in the two classes, and would probably be just the same were it not for the fact that one case unoperated upon left the house within two days following the injury. The mortality in the dorsal region is considerably less in the cases operated upon. The lumbar region shows about an equal mortality (5 per cent. in favor of the operated cases). An important fact to be remembered in

the cases marked improved is that these are frequently so prolonged as to pass from under the care of one surgeon and house surgeon into the hands of others, and thus the points in the case may be lost sight of. In one case improvement is said to have taken place in a patient who resided in the hospital 481 days after the injury was received. In another, 153 days elapsed between the time of admission and date of discharge. Such prolonged residence in the hospital argues against substantial or decided improvement. In none of the fifty cases does the record show complete recovery from the nervous symptoms. Eight of the cases recovered from the injury, but the nervous symptoms persisted.

Thorburn ("Contribution to the Surgery of the Spinal Cord") gives a total of fifty-six cases operated upon, thirty-eight of whom died ($67\frac{6}{7}$ per cent.). Eighteen recovered from the osseous injury, but only two were classified as recovered from the spinal cord symptoms. Sixteen showed either none or but slight improvement.

Dr. Samuel Lloyd (*loc. cit.*) has the following tables in his article. They bear more particularly upon the question as to the time for operation, and are certainly very suggestive when carefully considered.

CERVICAL REGION.	Immediate Operation.	Later Operation.
Deaths	21	2
Recovery	0	2
Improved	2	1
Not improved	0	4
Subsequent death	4	3
	—	—
	27	12

DORSAL REGION.	Immediate Operation.	Later Operation.
Deaths	23	5
Recovery	4	10
Improved	9	18
Not improved	6	16
Subsequent death	7	16
	—	—
	49	65

LUMBAR REGION.	Immediate Operation.	Later Operation.
Deaths	4	4
Recovery	1	6
Improved	1	6
Not improved	0	4
Subsequent death	0	2
	—	—
	6	22

SACRAL REGION.	Immediate Operation.	Later Operation.
Deaths	0	0
Recovery	0	1
Improved	0	3
Not improved	0	0
Subsequent death	0	0
	—	—
	0	4

One can readily see that these figures cannot be accepted as an accurate gauge of the situation, for the reason that the mortality will necessarily be higher in those cases that are subjected to an immediate operation, because a considerable proportion of them will have no chance to recover from the injury. By delaying operation, this not inconsiderable proportion of deaths is eliminated. One must therefore accept the statement that those cases in which operation is delayed are those which necessarily stand the best chance of recovering. It also necessarily follows that the cases which live for any considerable time after injury are those in which the injuries are less severe. Consequently, they are those in which good results would be obtained with either an early or late operation. Dr. Lloyd's statistics are therefore open to considerable criticism. It is not fair to assume that they did better because of the waiting. We should, however, consider the fact that this method is to be commended, because it removes the opprobrium of failure from a considerable proportion of cases in which failure was inevitable.

POST-TYPHOIDAL INFECTION OF RIBS.¹

BY J. SHELTON HORSLEY, M.D.,

OF EL PASO, TEXAS.

MR. C. B. M., Parral, Mexico, aged forty-two years, mining engineer, American. Family history negative, previous health excellent, except a severe attack of typhoid fever in the fall of 1900. A few weeks after convalescence had been fully established, pain and swelling occurred in the left side of the thorax, over the anterior end of the sixth rib and its costal cartilage. Pus formed and was evacuated by an incision. A sinus resulted, which a few months later was opened and curetted, but did not heal. He came under my care June 14, 1901. The patient was apparently very robust. There was a sinus opening at the centre of the sixth costal cartilage on the left side which discharged, in the course of twenty-four hours, about half an ounce of thick, tenacious, odorless pus. A probe would follow the costal cartilage to the sternum, and could be introduced for five centimetres in the other direction towards the rib, but no bare bone was detected. A rather imperfect examination of the pus showed a bacillus thought to be that of Eberth; no cocci or other bacteria were found.

Operation at St. Luke's Hospital, June 15, 1901, under chloroform. A twelve-centimetre incision was made over the sixth rib and cartilage, commencing at the sternum. All of the sixth costal cartilage was removed, most of the seventh, and part of the sternum. The perichondrium was curetted, care being taken to avoid injuring the internal mammary artery. The old sinus tract in the soft parts was cut away, the wound packed with iodoform gauze, and the skin partly approximated with silk-worm gut. He fully recovered from the immediate effects of operation. Temperature only reached 100° F. once. The wound, however, did not close, and patient left the hospital on July 14, with a sinus still discharging pus, though not so much as previous to operation. He was readmitted three weeks later, and operated on again under chloroform on August 11. A more extensive incision was made than at the previous operation, but in the same

¹ Read before the Southern Surgical and Gynecological Association, November, 1902.

direction, following the line of the sixth costal cartilage and rib. Some cartilage had reformed, and this, together with all of the seventh costal cartilage and adjoining portion of the sternum as far as the middle line, was removed. Then five centimetres of the sixth rib were resected, though apparently only one centimetre was diseased. As the pleura was not diseased or thickened at this point and would bulge out at each expiration, care was required to avoid injuring it. Wound was treated as after the former operation. He suffered a great deal from pleurisy for five days, and was not completely relieved by strapping the chest. Otherwise convalescence was uneventful. Patient left the hospital September 1 with a sinus discharging a small amount of seropus. Healing, though slow, was uninterrupted, and on October 10, 1901, the sinus closed. There has been no tendency to recurrence, and when last heard from (September, 1902) he was perfectly well.

Diseases of bones following typhoid fever are interesting from several stand-points, particularly from that of time of occurrence. Post-typhoid osseous lesions may arise at any time, either during the attack of fever or from a few weeks to months, or even years, after convalescence from the fever. This is due to the peculiar vitality of the bacillus of Eberth. Schiller (*Arbeit. kaiserlich. Gesundheitsamte*, Vol. v, p. 312) implanted the bacilli on silk threads, and found them alive and active from one to two years afterwards. He asserts that they can live on potato culture for two years. Within the body their length of life is even more remarkable. Von Dungern (*Münch. med. Wochen.*, 1897, No. 26, p. 699. Keen's "Surgical Complications and Sequels of Typhoid Fever," p. 250) reports an instance in the case of a woman, aged forty, who was ill from typhoid fever four weeks in November, 1882. After a number of attacks of various kinds, such as gastralgia, periostitis of the lower jaw, etc., a tumor formed in the region of the gall-bladder in October, 1896. This was accompanied by pain and occasional chills. By February, 1897, the tumor had enlarged to the size of a child's head and was opened, 150 cubic centimetres of pus being evacuated. Careful examination showed the presence of typhoid bacilli in pure culture. Buschke ("Lebensdauer d. Typhusbacillen in ostitischen," Herden

Fortschritte d. Med., 1894, p. 573; Keen's "Surgical Complications of Typhoid," p. 20) reports the case of a woman of sixty-six who had typhoid fever in 1886. Without any evidence of another attack, a swelling in the axilla was incised February, 1894, and pus containing a pure culture of typhoid bacilli evacuated.

Another remarkable fact is the length of time discharge from an open sinus due to diseased bone will show a pure culture of typhoid bacilli. G. Sultan records a case in which a sinus existed for six years, after which time the pus showed a pure culture of the bacillus of Eberth (Case No. 15 in table).

It was at first supposed that the infection was always mixed with the staphylococcus pyogenes, eventually showing pure culture of typhoid owing to the great vitality of the bacillus. The bacillus of typhoid fever is now admitted to be pyogenic on occasions, and the experiments of Dehu, Vincent, Vaillard, and Dmochowski and Janowski (Keen's "Surgical Complications of Typhoid Fever," p. 113) demonstrate that the viability of the staphylococcus is even greater than that of the typhoid bacillus. Consequently, when a pure culture of the typhoid bacillus is found, it is unlikely that the staphylococcus pyogenes was ever present.

There are five peculiarities that appear to differentiate post-typhoid disease of the ribs from similar disease of other bones.

First. The marrow of the ribs seems to be a particularly favorite seat of the bacillus in a patient convalescing from typhoid. This fact indicates a lower resistance in the ribs than in other bones. A number of observers found the bacilli in bone marrow, where they remained for some time without producing disease. Quincke (*Berlin. klin. Wochen.*, 1894, No. 15), in nine post-mortems, found the bacillus eight times in the marrow of the ribs and once in the bones of the extremities.

Second. The position of the ribs being superficial, their movement in respiration practically continuous, and several being subjected to the constant impact of the heart's action, would make a locus minoris resistentiæ more liable to occur here than in other bones.

Third. Paget (*St. Bart. Hospital Report*, 1876) asserts

that, though there is, rarely, necrosis of the costal cartilages, necrosis of the ribs never occurs. Clinical reports do not bear out this assertion, but it is true that necrosis occurs less frequently in the ribs than in other bones,—a fact which tends to separate diseases of the ribs from similar affections of other bones where necrosis is more common.

Fourth. Post-typhoid disease of the ribs occurs very largely in later life. Keen ("Surgical Complications of Typhoid Fever," p. 137) says that of thirty-two cases in his table the age is given in eighteen: five were from twenty to thirty years of age; six from thirty to forty, and seven over forty. In a lecture before the German Society of Naturalists, Helferich (*Berl. klin. Wochen*, 1890, Vol. xxvii, p. 979), after asserting that the disease is the direct result of typhoid bacilli, says that it is mostly observed in advanced age (from thirty-one to sixty-three years in his series of eight cases), and thinks this peculiarity is due to changes in the costal cartilage from age, as vascularization, breaking of fibres in the intercellular substance, etc.

Fifth. The difficulty of thoroughness in operative treatment is most pronounced in the ribs. Unlike cases of osteomyelitis from empyema or pneumonia, the pleura is usually but slightly thickened, and is frequently normal. Consequently, it is very readily wounded. Even when it is not, there is liability to pleurisy, as occurred in the writer's case. The proximity of the pericardium, and, in the lower ribs, of the diaphragm, may also deter the operator from thorough work in these localities.

This difficulty is well illustrated by the fact that each of the two cases of post-typhoid disease of the ribs reported by Parsons (*Johns Hopkins Hospital Reports*, 1895, Vol. v, p. 417) as having been surgically treated at Johns Hopkins Hospital during the year immediately preceding his report had to be operated upon twice before a cure was effected. The case of Keen ("Surgical Complications of Typhoid Fever," p. 129) is also in point. The patient developed disease of the right sixth and seventh costal cartilages following typhoid fever. An incision was made which gradually closed, but the swelling

continued. About sixteen years later, in July, 1894, the tumor over the affected ribs was incised by Dr. Rice and part of one rib removed. The operation resulted in a sinus, which never closed. A second operation was done in October, 1894. In January, 1895, the wound having never healed, the patient was operated on at the Pennsylvania Hospital by Dr. T. G. Morton, who removed a portion of the sternum and parts of some ribs without a cure. February 20, 1895, Dr. Keen did an extensive flap operation, removing between three and four inches of the fifth, sixth, and seventh ribs, which were found softened from osteomyelitis. The wound healed entirely, but later reopened, and a sinus leading to the sternum resulted. March 25, 1896, Dr. Keen again operated, removing more diseased bone. Healing was very slow, but finally complete.

The symptoms and signs of disease of the ribs following typhoid fever are much the same as in disease from other causes, with the exceptions that the bacillus of typhoid is frequently found, and that the disease rarely, if ever affects the patient's constitution,—which latter fact is in great contrast to similar lesions produced by tuberculosis, pneumonia, or trauma. The temperature and pulse are not raised, though there may be free suppuration. In the case reported at the beginning of this paper, the patient's general health was not impaired, though disease of cartilages, rib, and sternum was quite extensive.

Post-typhoid lesions of the ribs and sternum must be more frequent than the number of fully reported cases seems to indicate. Helferich (*Berl. klin. Wochen.*, October 20, 1890, p. 979) states that he has seen eight cases in five years. Berg, a Scandinavian physician, has had seven cases in his own practice (*Ctbl. f. Chirurgie*, 1896, p. 153). Meacham (Paget's "Surgery of the Chest," 1896) saw four cases in the course of a single year's work. Though many reports, like Helferich's, Berg's, and Meacham's, are in such a fragmentary state that they cannot be used for tabulation, every effort has been put forth to make the following table contain all reported cases where sufficient data are given.

TABLE OF DISEASES OF THE RIBS FOLLOWING TYPHOID FEVER.

No. of Case.	Operator and Reference.	Sex and Age.	Ribs Affected.	Kind of Disease.	Time of Appearance.	Treatment and Remarks.
1	A. S. Grimm; Medical Record, New York, 1895, Vol. xlviii, p. 381.	Man.	Fifth, sixth, and seventh ribs; side not given.	Periostitis.	Pain and redness over sixth rib, in third week of fever; fluctuation about three months after recovery; pus evacuated and sinus resulted; (bacillus of Eberth found.)	Radical operation a year after abscess was lanced; sixth rib partly removed, fifth and seventh curetted; slow but complete recovery.
2	Richard Lampe; Deutsche Zeitschrift für Chirurgie, Leipzig, 1899, p. 603.	Young man.	Fifth, sixth, and seventh ribs and costal cartilages on left side.	Perichondritis and chondritis.	Was never free from pain in chest after fever; swelling appeared four months after recovery.	Resection of fifth, sixth, and seventh cartilages; perfect recovery; typhoid bacillus found.
3	J. C. Wilson; Medical and Surgical Reports, Philadelphia, 1891, Vol. lxiv, p. 733.	Man, 32 years.	Sixth rib, right side, at junction with cartilage.	Caries, chiefly of cartilage.	About a year after recovery from typhoid.	Operation refused; injection of methyl-violet every three or four days; cure.
4	S. O. Lewis Potter; Pacific Medical Journal, San Francisco, 1889, Vol. xxxii, p. 593.	Druggist.	Swelling over right side of sternum below left nipple, and one over third right rib, and over fifth, seventh, and eighth ribs.	Periostitis.	About four or five months after recovery from typhoid.	Swellings incised; only dark blood evacuated; iodide of iron and manganese given; improved but not cured.

5	Same reporter and reference.	Precher.	A large swelling over ribs; no details.	Necrosis of ribs.	.....	Excision of diseased ribs performed twice without recovery; in both this and the preceding case large doses of ant fibrin had been given during the attack of typhoid.
6	Same reporter and reference.	Man.	Left lower ribs.	Necrosis.	Soon after recovery from typhoid.	Operated upon several times with improvement but not cure; excision of diseased bone.
7	Reported by Albertine; operator, Maurice Pollosson; La Province medicale, Lyon, 1895, Vol. ix, p. 173.	Woman, 29 years.	Anterior extremity of seventh rib, right side.	Osteomyelitis.	Tumor appeared about two months after recovery from typhoid.	Incision and curettement; end of rib contained a cavity lined with fungoid granulations; cure.
8	Same reporter, operator, and reference.	Man, 35 years.	Anterior end of sixth rib, right side.	Osteomyelitis.	Pain commenced fifteen days after cessation of fever; about two months later an acute abscess formed and broke, leaving sinus.	Operation about three weeks after sinus formed; bone cavity in end of sixth rib curetted; sinus still remained.
9	Same reporter, operator, and reference.	Man, 56 years.	Sixth and seventh ribs, left side.	Osteomyelitis.	Had pain in sixth and seventh ribs during fever; about three months later an abscess formed and left a sinus which was operated on eighteen months later.	Curettement of anterior extremity of sixth rib, which contained a cavity; affection called "costal medullitis of typhoid nature;" wound was healing nicely when case was reported.

TABLE OF DISEASES OF THE RIBS FOLLOWING TYPHOID FEVER.—*Continued.*

No. of Case.	Operator and Reference.	Sex and Age.	Ribs Affected.	Kind of Disease.	Time of Appearance.	Treatment and Remarks.
10	Same reporter, operator, and reference.	Man, 42 years.	Fifth rib, right side, and adjoining portion of sternum.	Osteomyelitis.	One month after onset of fever pain was noted on right side of sternum; in ten days there was local swelling, and three months later an abscess formed and broke, leaving a sinus.	A cavity was found in sternum at insertion of fifth costal cartilage on right side; curetted; complete cure.
11	Same reporter and reference; operator, Jaboulay.	Man, 40 years.	Sixth rib, right side.	Osteomyelitis.	Swelling appeared during convalescence; abscess formed and broke, leaving a sinus.	Operation about six months after inception of fever; curettement and removal of a portion of sixth rib; cure after long convalescence.
12	Same reporter and reference; operator, Terrier.	Man, 29 years.	Seventh and eighth ribs, left side, their costal cartilages and adjoining portion of sternum.	Osteomyelitis, with arthritis and necrosis.	Abscess formed during convalescence and was opened, leaving a sinus.	A small sequestrum found, corresponding to outer table of the bone; resection of three centimetres of seventh and ten centimetres of eighth ribs; rapid recovery.
13	Same reporter and reference; case of Vidal.	Woman, 24 years.	Swelling under right nipple.	Ostitis.	At beginning of convalescence.	Swelling persisted for four years, then formed an abscess and persisted as a sinus for five years longer, when three sequestra were expelled and the wound rapidly closed.

14	Same reporter and reference; operators, Achard and Broca.	Man, 27 years.	Left border of sternum; rib not mentioned.	Osteitis.	Tumor appeared during course of typhoid fever; three months later it was incised and pus evacuated.	Bacillus of Eberth found; recovery in one month.
15	G. Sultan; Deutsche med. Wochenschrift, August 23, 1894, Vol. 20, p. 675.	Woman, 35 years.	First and twelfth and clavicle, right side.	Osteomyelitis.	During convalescence two abscesses appeared, which were opened and formed sinuses.	Radical operation six years after typhoid; two sequestra removed and the diseased bone curetted; prompt recovery; bacillus of Eberth in clavicular lesion, the other not examined.
16	C. Achard and A. Broca; Gazette hebdomadaire de Médecine et de Chirurgie, Paris, 1895, Vol. xxxii, p. 42.	Seaman, 26 years.	Left eighth costal cartilage.	Chondritis.	During convalescence a circumscribed tumor over eighth costal cartilage formed.	Operation a few weeks later; the tumor consisted of a mass of granulation tissue; two and one-half centimetres of left eighth costal cartilage were removed, including tumor; recovery; typhoid bacillus found.
17	Carl Caspersohn; Festschrift für Friedrich von Esmarch, 1893, p. 453.	Woman, 33 years.	Seventh and eighth ribs; also tibia, olecranon, and other places.	Osteitis.	.....	Tibial tumor operated upon, other got better; unguentum cinereum prescribed; probably cured.
18	Otto Barbacci; Lo Spertimentale, Florence, 1894, Vol. xlv, p. 365.	Man.	Right fifth rib, near sternum.	Periostitis.	During convalescence, before fever had entirely subsided, a swelling appeared over fifth rib.	Abscess was formed and was opened, and three or four centimetres of the fifth rib excised; result not stated; typhoid bacillus found in pus.
19	Englisch; Wiener Med. Presse, 1867, p. 1204.	Man, 33 years.	Seventh and eighth ribs.	Periostitis.	About one and a half months after convalescence from typhoid.	Abscess formed and broke; no operation.

TABLE OF DISEASES OF THE RIBS FOLLOWING TYPHOID FEVER.—*Continued.*

No. of Case.	Operator and Reference.	Sex and Age.	Ribs Affected.	Kind of Disease.	Time of Appearance.	Treatment and Remarks.
20	Leon Duclos; Des Complications Osseuses Provoquées par le Bacille d'Eberth, dans la fièvre typhoïde, Paris, 1895, p. 22.	Man, 22 years.	Sixth and seventh ribs.	Osteitis.	Immediately after convalescence.	Incision and curetting of wound; recovery.
21	Same reporter and reference.	Physician.	Tumor developed under right nipple.	Osteitis.	During convalescence from typhoid.	Incision evacuated a quantity of pus; recovery.
22	Buschke (case treated by Hellerich); Fortschritte der Medizin, Berlin, 1894, Vol. xii, p. 575.	Woman, 66 years.	Fifth and sixth ribs, right side.	Periostitis.	During convalescence from typhoid.	Incision and curetting wound and affected part of rib; cure; bacillus of Eberth found.
23	Paul Hoffman; Zur Casuistik der Knochenerkrankungen nach Typhus Abdominalis, Greifswald, 1888, p. 17.	Man, 61 years.	Fifth and sixth ribs, at junction with sternum, right side.	.....	Two and a half months after recovery from typhoid.	Excision of ends of affected ribs; recovery.
24	Same reporter and reference.	Man.	Right sixth rib.	.....	Three months after attack of typhoid.	Excision of the end of sixth rib; recovery.
25	C. Vianay; Archives provinciales de chirurgie, Paris, 1900, Vol. ix, p. 323.	Seaman, 26 years.	Left eighth rib.	Chondritis.	During convalescence from typhoid.	Excision of costal cartilage and end of rib; recovery.

26	Same reporter and reference.	Man, 36 years.	Right fifth costal cartilage.	Chondritis.	Shortly after recovery from typhoid.	Excision of two centimetres of cartilage; recovery.
27	F. Finney; Transactions Colorado State Medical Society, 1899, p. 246.	Woman, 35 years.	Left sixth rib, half inch from sternum.	Necrosis.	Three weeks after recovery from typhoid.	Necrosed bone scraped out; recovery.
28	Same operator and reference.	Man, 36 years.	Right sixth rib.	Necrosis.	About fourteen months after recovery from typhoid.	Necrosed bone scraped out; recovery.
29	Same reporter and reference.	Man, 55 years.	Sixth rib, sternal articulation.	Necrosis.	About three weeks after attack of typhoid.	Necrosed bone scraped out; operation only partially successful; second operation, result not mentioned.
30	A. Ruais; Les manifestations osseuses de la fièvre typhoïde, Paris, 1899, p. 31.	Man, 34 years.	Left first rib.	.....	Three weeks after attack of typhoid.	Excision of necrosed rib; recovery.
31	Ernst Kuster; Med. Chirurgie Central., Wein, 1882, Vol. xvii, p. 473.	Man, 46 years.	Fifth to eighth ribs, right side.	Perichondritis.	During convalescence from typhoid.	Excision of diseased cartilage and ends of ribs.
32	Jackson; British Medical Journal, 1885, Vol. 1, p. 428.	Man, 42 years.	Left third rib.	Periostitis.	About four weeks after attack of fever.	Abscess broke, some necrosis of rib; spontaneous recovery after seven months.
33	Parsons; Johns Hopkins Hospital Report, 1895, Vol. v, p. 417.	Man, 35 years.	Left seventh costal cartilage.	.....	Pain during convalescence; a month later tumor appeared.	Tumor incised a month after its appearance; only blood evacuated, but sinus resulted; four months later curetting, which was unsuccessful; four weeks later excision of cartilage; cure after seven months; bacillus of Eberth found.

TABLE OF DISEASES OF THE RIBS FOLLOWING TYPHOID FEVER.—*Continued.*

Case No.	Operator and Reference.	Sex and Age.	Ribs Affected.	Kind of Disease.	Time of Appearance.	Treatment and Remarks.
34	Same reporter and reference.	Woman, 43 years.	Seventh, eighth, and ninth ribs, right side.	.....	Pain appeared four months after recovery; fifteen months later a tumor developed.	Excision of sinus and cartilage about a month after tumor appeared; sinus resulted; second operation of excision eleven weeks later; healed six months later; bacillus of Eberth found.
35	Same reporter and reference.	Man.	Left eighth rib.	Periostitis. (?)	Pain appeared during convalescence; two months later swelling with but little soreness; this subsided, and five months afterwards the swelling reappeared and subsided after six months, leaving a painless induration.	Guaiacol used locally during first swelling.
36	Valentini; Deutsche med. Wochenschrift, 1892, No. 22, p. 509.	.....	First rib. (?)	Perichondritis. (?)	Pain over ribs occurred day after typhoid temperature became normal, and in eight days there was a fluctuating tumor.	About ten cubic centimetres of pus showing Eberth's bacillus were evacuated by incision through pectoralis major.
37	Paget; Surgery of the Chest, 1896, p. 157.	Man, 40 years.	Left lower rib.	Periostitis and caries.	Some months after typhoid, first symptoms appeared; pus formed and was evacuated, leaving a sinus.	Curettement of diseased cavity was unsuccessful; resection of costal cartilage was followed after a long time by complete cure.
38	Keen's Surgical Complications and Sequels of Typhoid Fever, p. 128.	Man, 42 years.	Fifth, sixth, and seventh ribs, right side.	Osteomyelitis.	During convalescence.	Six operations before permanent cure was effected; typhoid bacilli not found.

39	Same reporter and reference, p. 133, case of Rice.	Man, 40 years.	Eighth and ninth ribs, right side, and sternum.	.....	Three months after attack of typhoid.	Phosphates internally; incision and drainage; patient not cured.
40	Keen; Philadelphia Medical Journal, March 3, 1900, p. 508	Man, 49 years.	Fifth and sixth ribs on right side, and sixth and seventh on left side.	Osteomyelitis.	Pain developed during convalescence; two months later abscess appeared on both sides and broke, leaving sinuses.	Sinuses were open about ten months before radical operation was attempted, when typhoid bacilli were found in pure culture; after excision of diseased ribs and cartilage, wounds slowly healed, and nine months later were well.
41	Keen; Personal communication.	Man, 25 years.	Third to sixth ribs on right side, at junction with sternum.	Typhoid abscess from periostitis.	.....	Incision showed most of the diseased ribs dissected from soft tissue by the abscess; cavity was scrubbed with gauze sponges, some infiltrated muscular tissue cut away, dusted with iodoform gauze; patient discharged from hospital two weeks after operation, with wound almost healed.
42	Bernays; Personal communication.	Boy, 19 years.	Sixth or seventh rib.	Periostitis and necrosis.	Symptoms began eight weeks after typhoid fever, and four weeks later abscess broke.	Excision of necrosed rib, two and a half inches long; wound packed with gauze and healed within three months; complete recovery.
43	Tinker; Philadelphia Medical Journal, March 3, 1900, Vol. v, p. 509.	Man, 31 years.	Right ninth rib in middle axillary line.	Necrosis.	Soon after convalescence.	Incision and curettement; cure.

TABLE OF DISEASES OF THE RIBS FOLLOWING TYPHOID FEVER.—*Continued.*

No. of Case.	Operator and Reference.	Sex and Age.	Ribs Affected.	Kind of Disease.	Time of Appearance.	Treatment and Remarks.
44	Schuster; Personal communication.	Priest, about 50 years.	Left lower, probably seventh or eighth rib.	.....	A few weeks after convalescence.	Patient has been operated on a number of times by different operators, but sinus still persists.
45	W. L. Brown; Personal communication.	Man, 69 years.	Third costal cartilage, right side.	Perichondritis.	Two weeks after convalescence.	A hard swelling which resolved.
46	Same reporter and reference.	Man, 35 years.	Anterior end of seventh rib and its costal cartilage.	Osteomyelitis.	Six weeks after convalescence.	Abscess formed and was opened, and diseased bone curetted; recovery.
47	J. F. McConnell; Personal communication.	Man, 41 years.	Left seventh rib.	Periostitis.	During convalescence.	A hard swelling first formed and disappeared, then reappeared and formed abscess and was incised; soon healed.
48	J. S. Horsley.	Man, 42 years.	Left sixth and seventh ribs.	Osteomyelitis and chondritis.	A few weeks after convalescence.	Abscess formed, was opened, and later curetted, leaving sinus, which required two radical operations, resecting diseased ribs and cartilage; complete cure.

ANALYSIS OF THE TABLE.

This table contains forty-eight cases. In twenty cases more than one rib was diseased. It is certain that there is a much larger number than this. Keen's "Surgical Complications and Sequels of Typhoid Fever," published in 1898, has a list of forty diseased ribs following typhoid; this table, compiled four years later, presents seventy-eight. Calling attention to this subject, as Keen's book did, served to stimulate the accuracy of observation and frequency of reports of such cases, for it is not possible that such a sudden increase of reported cases within four years can be due to any other cause.

Sex.—The sex is stated in forty-seven of the forty-eight cases. Forty are men and seven women. This is mostly owing to a much larger number of men having typhoid, but it would seem that the proportion in diseases of the ribs is unduly great. In woman the greater blood supply to the chest wall, on account of the mammae, may explain this comparative immunity, as the resistance to infection would be thereby increased.

Age.—A peculiarity above alluded to is that post-typhoid diseases of the costal cartilages and of the ribs, according to the table, uniformly occur in adults. Of forty-eight cases the age is mentioned in thirty-eight. The youngest is a boy of nineteen (Case No. 42); the oldest sixty-nine (Case No. 45). Under twenty there is one case; between twenty and thirty there are eight; between thirty and forty, twelve; between forty and fifty, ten; between fifty and sixty, three; between sixty and seventy, three.

Locality.—In seven cases the ribs affected are not definitely mentioned. In the remaining forty-one they are as follows:

In the right side, the first rib was affected once; the third, three times; the fourth, once; the fifth, nine times; the sixth, eleven times; the seventh, four times; the eighth and ninth, each three times, and the twelfth, once.

On the left side, the first rib was affected once; the third, once; the fifth, once; the sixth, five times; the seventh, six times; the eighth, five times.

In cases in which the rib was mentioned, but not the side, the first rib was affected once; the fifth, twice; the sixth, three times; the seventh, five times; and the eighth, three times.

Two cases are reported in which ribs on both sides of the chest were diseased. Deducting these, there are thirty-six cases in which the side is mentioned, of which twenty-one are reported as on the right and fifteen on the left.

It would naturally be expected that, owing to the additional trauma of the heart's impulses, the left side would be the one most frequently diseased; such, however, is not the case.

In sixteen cases either the anterior end of the rib or the costal cartilage is reported as being the seat of disease.

Kind of Disease.—It is difficult to classify the kinds of disease, for one case may have several kinds, or one disease may be followed by another as a sequel. For instance, periostitis frequently results in osteomyelitis or osteitis. There are seven cases in the table in which the kind of disease is not reported. In the remaining number, osteomyelitis occurs eleven times; periostitis, eleven times; necrosis, eight times; osteitis, five times; caries, twice; chondritis, five times; perichondritis, four times.

These terms are often used loosely and inaccurately, but, making all allowance, it would seem that necrosis of the ribs does occur, despite Paget's assertion to the contrary. In Case 13, three sequestra were expelled; then the wound rapidly closed. In Case 15, two sequestra were removed, and prompt recovery followed. In Case 12, a small sequestrum was found.

Time of Appearance.—In classifying cases under this head where symptoms do not occur simultaneously, continuous pain in the region subsequently showing pathological changes, is taken as the date of onset, unless swelling is first noted. Frequently the pain would subside, and it would be months or years before the lesion developed, but the disease must have merely remained quiescent during this period.

It was found necessary to put in the classification the term "During convalescence." Cases under this head probably occurred during the first six weeks after the temperature from

the typhoid attack had become normal, yet the writer does not feel justified in so classifying them. In four cases the date of onset is either not mentioned or it is too indefinite to be classified. During the attack of typhoid fever, four cases occurred; during first two weeks after fever, one case; from two weeks to six weeks after fever, nine cases; from six weeks to six months after fever, two cases; from one year to three years, two cases; during convalescence, nineteen cases.

This illustrates the length of time in which the typhoid bacillus may be present and remain apparently inert.

Prognosis.—In general, it may be said that the prognosis as to permanent cure is not invariably good, though under intelligent and persistent treatment there is usually complete recovery.

Treatment and Results.—The treatment mentioned in the table includes everything from "masterly inactivity" to most extensive resections, and seems to depend largely upon the case. Some cases are so mild that they resolve and disappear under practically no treatment, while others may tax the ability of the surgeon to the utmost, and require repeated operations before a successful termination is achieved. In the obstinate cases, nothing short of most radical procedures, going some distance into apparently healthy bone, will accomplish a satisfactory result. For this reason a summary of different methods of treatment and their results would be misleading. For instance, two cases (Nos. 35 and 45) resolved, apparently requiring no local treatment; on the other hand, Case 38 required six operations, the last three being most radical ones, before a cure was effected. Case 44, after a number of operations by different surgeons, still has a sinus.

Of some interest in the matter of treatment is Case 3, where operation was refused, and a cure effected by injecting the sinus with methyl-violet solution every three or four days.

No definite rule can be laid down, but it would seem that, if resolution fails to occur, incision and curettage should be practised. If this procedure appears unsuccessful after a few weeks, the diseased ribs and cartilages should be extensively resected.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, November 12, 1902.

The President, LUCIUS W. HOTCHKISS, M.D., in the Chair.

PYLORECTOMY FOR CARCINOMA.

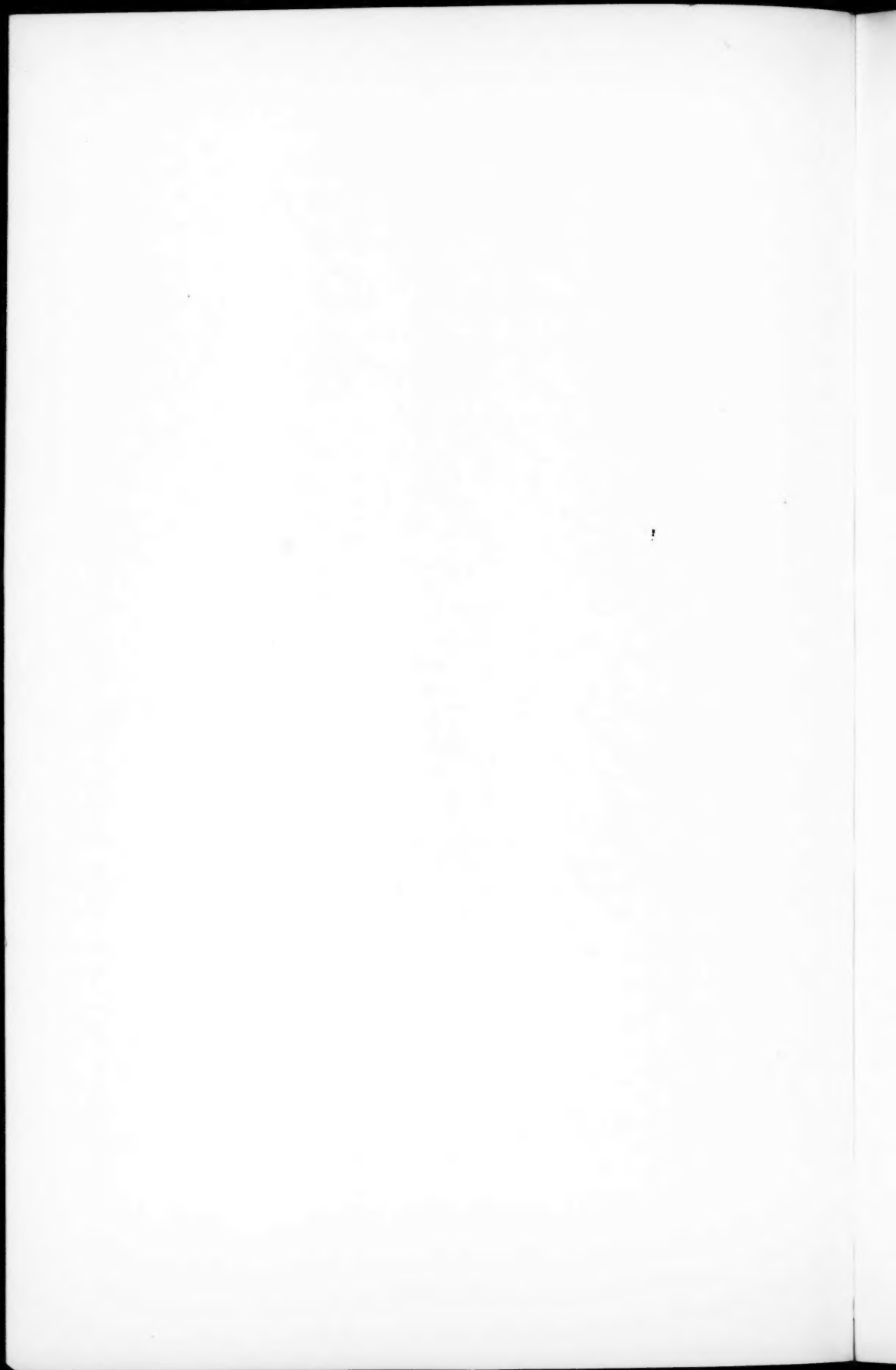
DR. CHARLES N. DOWD presented a man, fifty-one years old, who had suffered since boyhood with digestive disturbance, his principal symptoms being flatulence, pyrosis, and occasional vomiting. Last January, in addition to these symptoms, he began to lose flesh, and gradually became so weak that he was unable to do his usual work, suffering greatly from dyspnœa on very slight exertion.

July 29, when he came to the city, he was thin, anæmic, and weak. Palpation and auscultation revealed no disease of the internal organs. The stomach was not dilated, and no pyloric enlargement could be felt. Examination of stomach contents, however, showed absence of free hydrochloric acid after either Ewald's or Boas's test meals, and there was no lactic acid. Blood examination showed red blood-corpuscles, 2,408,000, in one cubic millimetre; leucocytes, 10,060, in one cubic millimetre; hæmoglobin, 60 per cent. of normal.

In view of the man's general condition and the absence of free hydrochloric acid in the stomach, an exploratory operation was done August 6. A nodule was found in the posterior wall of the pyloric end of the stomach, which was situated so high that the ribs had prevented its palpation. The growth projected into the stomach cavity from its posterior wall and obstructed the pylorus on account of its size. It did not infiltrate the circumference of the pylorus. Three or four of the neighboring lymph nodes were very slightly enlarged.



Persistent thyroglossal duct extending from the hyoid bone to the thyroid gland. It seemed to extend to the isthmus of the thyroid gland, but was so intimately blended with its right lobe that it could not be separated from it. The sinus discharged small amounts of mucopurulent fluid.



Pylorectomy was done. Clamps were placed at the cardiac side of the pylorus, but the portion of the stomach which was left in was not subjected to clamp pressure. Its margins were inverted, and stitched together with silk as they were cut; and a second row of similar stitches brought the peritoneal surfaces in firm apposition across the resected stomach edge. A silkworm-gut purse-string suture was then placed about the first portion of the duodenum, in which half of a Murphy button was placed as soon as it was severed from the pylorus. When this suture was tightened, the peritoneal edges of the duodenum came within one-quarter of an inch of each other, and were then brought together by silk stitches. The other half of the Murphy button was then inserted in the posterior stomach wall and union was made without particular difficulty, a row of silk stitches being used to increase the peritoneal apposition.

The patient made an uneventful recovery, and was able to take food by mouth after three days. Since the operation, he has gained about twenty-five pounds in weight. The button was passed on the twelfth day.

In connection with this case, Dr. Dowd showed the specimen, which was an adenocarcinoma.

PERSISTENT THYROGLOSSAL DUCT.

DR. DOWD presented a child which was brought to St. Mary's Hospital last spring. At that time it was two years old, and presented a nodule near the median line of the front of the neck, with a discharging sinus. On account of its location, it was not regarded as a lymph node, and upon cutting down upon it, it proved to be a rather unusual demonstration of a persistent thyroglossal duct. It could be distinctly traced up to the hyoid bone and down to the thyroid gland, into which it merged, so that the line of demarcation between it and the thyroid could not be distinguished. (See figure.) It was dissected out as completely as possible, and the child made an uneventful recovery.

A microscopical examination of the walls of the duct showed a combination of squamous, columnar, and ciliated epithelium. In some places the mucosa resembled that of the cesophagus, but continuous with this squamous epithelium, columnar ciliated epithelium was to be found arranged like that of the trachea; other sections were distinctly thyroidal in their structure.

In following down this duct, Dr. Dowd said, it led towards the right lobe of the thyroid instead of the left, as is usually the case, and further away from the median line than these ducts are ordinarily described to be.

ABSCCESS OF THE LIVER OF TRAUMATIC ORIGIN.

DR. JOHN F. ERDMANN presented a man, forty-one years of age, who was seen by him on Friday, September 26, 1902. At this time he obtained the following history: Pain in the right lumbo-iliac region, with rigidity of the muscles, and temperature of 102° F., and pulse 120 on the date preceding his visit. He had been feeling badly for two or three days. Had vomited and had had chills. Upon examination, the upper half of the right rectus was found to be rigid; his temperature was 99.5° F. and pulse 100; marked tenderness in the appendicular and gall-bladder region. He was sent to the hospital and operated upon in two hours. Upon exposure of the peritoneal cavity, a quantity of brownish-red pus welled up into the incision. This was found to come from the lower border of the right lobe of the liver through a small perforation about the size of a goose-quill. This led to an abscess cavity in the lower border of the liver about the size of a lemon, which extended from the ventrad to the dorsad surfaces of the right lobe. A large sloughing area formed the periphery of the abscess cavity. The cavity was packed and the patient sent to bed. While the patient was lying upon the operating-table previous to taking the anæsthetic, he was seized with a sharp attack of pain that was so intense that it caused a profuse perspiration to break out all over his body. This pain was located by the patient about two inches above and to the right of the umbilicus. This evidently was the perforating of the abscess.

At a later date clearer and more definite history was obtained. He said that frequently during his work he would support large boxes, heavy weights, barrels, etc., by pressure against this region, and that possibly three or four weeks before his operation he had injured himself by coming sharply in contact with the pole of his truck, as the result of a fall produced by lifting one of these heavy weights, the force of the blow being received in the right hypochondriac region. He had always been healthy previous to this date, never had had any chill until a few days after the injury, and that he had then had chills, which he only described

as chilly sensation. That on the Sunday preceding my visit he had felt ill and had a slight sore sensation on the right side. That on the Wednesday following he had considerable pain, and that on the day following, or the day preceding the one on which Dr. Erdmann saw him, the pain was extremely severe in this region.

DR. BERN B. GALLAUDET recalled a similar case which came under his observation two years ago. The patient was a boy, five or six years old, who had always enjoyed perfect health. One day, while playing with his father, the latter's elbow accidentally struck him over the region of the liver. The blow was somewhat painful, and in the course of two weeks or so a swelling gradually developed over the liver, and with but slight symptoms of general infection. The boy was brought to the hospital, the abdomen was opened, and an abscess of the liver found. An examination of the pus showed simply a staphylococcus infection.

DR. F. KAMMERER said that in these cases of abscess of the liver of traumatic origin there is probably a hæmorrhage into the substance of the organ, with secondary infection. He did not think that the traumatism was the direct cause of the abscess.

EXCISION OF THE TONGUE FOR SARCOMA.

DR. ARTHUR L. FISK presented a man of seventy-one years of age, a farmer; he had not had either gonorrhœa or syphilis. Previous to ten years ago he was a great smoker, and had chewed tobacco to within two months. About ten months ago he bit the tip of the tongue on the right side; following this, the tongue was sore and very painful, and grew continuously larger. When he came under observation in the early part of September, the tongue was so large that he could not close his mouth; the right half was larger than the left. The tongue was fissured, but not ulcerated; the growths were beneath the mucous membrane in the muscles of the tongue, and were smooth and elastic. They were painful on palpation. There were no enlarged glands in the neck. The man was greatly emaciated, cachectic, and very weak. The pain was so intense that morphine had to be administered in constantly increasing doses, and only with the greatest difficulty could he take liquid food. On September 17, 1902, the tongue was excised, the lingual artery on the right side being first ligated in the neck. The stump of the tongue was drawn

well forward and stitched to the floor of the mouth, and the mucous membrane was brought together by fine catgut suture. The mouth was constantly cleansed with hydrogen dioxide. Convalescence was uninterrupted. Food was taken readily, and in large quantities, and the man steadily improved. The growth was examined by Dr. E. E. Smith, who reports, "Sections of the area of new growth reveal the structure of small round-cell sarcoma."

For three weeks the patient has been exposed to X-ray every fourth day for fifteen minutes. There is not the slightest evidence of any recurrence as yet, which is unusual, when it is considered that a palliative and not a radical operation was done.

BILATERAL COXA VARA.

DR. ROYAL WHITMAN presented a boy, thirteen years old, with a peculiar waddling gait which was due to a bilateral coxa vara. On account of the gait, the lordosis, and the great projection and elevation of the trochanters, the case might readily be mistaken for one of double congenital dislocation of the hip, especially as the mother insists that the child has always walked in this manner, although he has grown worse within the past two years.

Dr. Whitman called attention to the persistent adduction of the right limb, which caused an apparent shortening. He proposed to remedy the deformity by first stretching the contracted muscles, and then removing a cuneiform section of the shaft of the femur below the trochanter in order to restore the normal range of abduction.

SCLEROSIS OF THE BRAIN CORTEX.

DR. GEORGE WOOLSEY presented a woman, forty-six years old, who was admitted to the Presbyterian Hospital on October 14, 1901. Her family history was negative, and her previous history unimportant. Five years ago she fell down a flight of stairs; she did not lose consciousness, but was dazed, and sustained a laceration over the left zygoma and a bruise on the left side of the head, an inch and one-half above the left temporomaxillary joint. A month after the accident she noticed a slight tremor of the terminal phalanges of the first and second fingers of the right hand. This recurred in the form of seizures, and in subsequent attacks the region involved increased upward, until, at the end

of three years, the whole forearm was affected. At this time the patient first noticed a loss of sensation in the right hand, though during attacks all sensation is lost in the affected area. Subsequently, in these attacks, the tremor developed into a powerful twitching, and involved the arm, shoulder, right side of chest, neck, face, and tongue. For the last four months the power of speech has been lost during the attacks. The attacks lasted from one to fifteen minutes, beginning in the fingers and terminating in the lips. They occurred at irregular intervals, sometimes as many as fourteen in a single day, and again she would be entirely free from them for several months. They were gradually becoming more frequent and severe, and there was increasing loss of strength in the affected area.

An examination showed a marked increase of the tendon reflex in the right leg. There was a decrease of the reflexes in the right hand, both superficial and deep. The sensations to heat, cold, pain, and pressure in the right hand and arm were impaired, and there was marked loss of power. Astereognosis in the right hand.

The patient was kept under observation for some days in the hospital, and during this period the character of her attacks was carefully noted. The attacks were preceded by a sensation of intense burning, which was referred to the right arm; then there was twitching of the fingers, gradually extending to the arm and face, resulting in clonic spasm of the parts involved. During the attacks the head was turned to one side; there was no loss of consciousness. The attacks were typically Jacksonian in character, and a probable diagnosis of tumor, involving the cortex of the brain, was made. During this period an examination of the patient's eyes by Dr. Chas. Stedman Bull led him to believe that her symptoms were not due to the presence of a tumor, but were more indicative of syphilis.

Operation, October 19, 1901, by Dr. Woolsey. A quadrilateral bone and skin-flap were removed over the centre of the motor area by means of an electric saw after openings had been made in the four angles by a burr. The dura was divided and the brain was found to be pulseless. In the motor area and beyond it, a marked change in its color was noticed; instead of the normal color, it was yellowish in appearance and firm in consistence. Two soft areas, however, were found; these were aspirated, and

a little serosanguineous fluid removed. The area of the brain, which was abnormal in color and consistency, was of considerable size, irregular in outline, and extended from behind the arm centre downward and forward over the motor area. Two small sections of this altered brain tissue were removed for microscopical examination, and the cut surface showed several small brownish-red spots, such as are often seen in a section of a glioma. The section of bone removed from the skull was not replaced, to afford relief for increase of intracranial pressure.

On the day after the operation, the patient complained of headache, otherwise no change in her condition was noticed. On October 22 there was increased power of extension of the right fingers. On the following day she was unable to speak, and the loss of tactile sensation had extended to the left side of the face. These symptoms were temporary, and were supposed to be due to pressure from oozing, which was quite free. On October 30 the stitches were removed. During this period the patient had a number of slight attacks of twitching, limited mostly to the thumb and index-finger of the right hand; she also complained of occasional pain in the right arm and shoulder. She was discharged, improved, on November 14, 1901.

The two sections removed from the cortex of the brain were submitted to the pathologist of the hospital, and proved to be a sclerosis, probably due to a syphilitic arteritis.

Dr. Woolsey said he saw this patient again about ten months after the operation, and learned that she had improved very much. After this she grew worse for a time and then again improved up to the present time. She still has attacks of twitching and pain, but they are less frequent and severe in character, and she has regained a good deal of power in her right arm and hand. There is still loss of the muscular and tactile senses. An interesting feature of this case was the marked and lasting improvement which followed the operation, though nothing was done except to relieve the pressure, while the continued administration of antisyphilitic treatment had given no result.

FIBROMA AND CYST OF THE BRAIN.

DR. WOOLSEY presented a boy of nineteen, who entered the Presbyterian Hospital, August 21, 1902. His family history was negative. He had never been addicted to the use of alcohol, and

gave no history of venereal disease. Five years ago he was struck on the left side of the head by a barrel, which fell about five feet. He received a scalp wound, but was not rendered unconscious by the blow. Three years ago, after retiring for the night, a sharp pain began in the left hand and crept up the arm to the shoulder. The pain was accompanied by twitching, which extended up to the left side of the face, and this gradually developed into a tonic spasm, and was followed by a loss of consciousness which lasted about half an hour. When he regained consciousness he felt well, and there was no resulting paralysis, stiffness, or pain. Two or three months later, while sitting in a chair, he had an exactly similar attack which lasted for fifteen minutes. A month later he had a third attack, and during or after this and the previous attack he limped on the left leg. After the first attack he had occasional seizures of slight pain and muscular spasm, once or twice in twenty-four hours, every day or two, which grew less after the last attack, and occurred for the last time about a year ago. During the course of his illness, there has been a gradual, progressive paralysis of the face, arm, hand, and leg of the left side. There are no distinct sensory disturbances.

Two months ago he had a severe headache, which improved and gradually disappeared after an attack of vomiting. It was at first general, but later became localized in both temporal regions. Similar headaches were complained of one and six weeks later. His chief complaints, when he was admitted to the hospital, were headache, weakness of the left leg and left side of face, and loss of function of the left arm. An examination showed some evidence of left facial paralysis. There was double optic neuritis. The pupils were equal, and reacted to light. The left upper extremity was almost completely paralyzed. The muscles were soft and flabby, but there was little wasting. The muscle and tendon reflexes were exaggerated. The left lower extremity showed loss of power; the muscle and tendon reflexes were exaggerated; ankle-clonus and Babinski's reflex were present. No abdominal reflexes were obtainable on the left side.

Operation.—On August 27, 1902, Dr. Woolsey removed a rectangular flap of scalp and bone over the motor area on the right side of the head. The bone flap was two and one-half by three inches in dimension, and was removed by means of the electric saw after openings had been made in the four angles by a burr.

Upon turning back the flap, it was observed that the dura did not pulsate. A flap of dura was then turned back, through which the brain protruded very markedly. The surface of the brain then began to split spontaneously, and through this fissure a bluish cyst wall could be seen; this ruptured spontaneously, and the fluid which it contained spurted fifteen to eighteen inches into the air. It was a fairly clear, straw-colored fluid, and about four or five ounces escaped.

Upon enlarging the opening in the brain, the cyst was found to measure about two by three inches in diameter, and to its inner wall an oval, hard, somewhat nodular tumor was attached; the latter was about an inch and one-half in length and an inch and one-quarter in width. The tumor was free on its outer side and in front, but internally and posteriorly it was quite firmly attached to the cyst wall. By pressure with the finger the attached portion was shelled off from the brain without much difficulty. The cyst was drained posteriorly, and the bone flap was replaced.

The same evening the patient could lift his left arm and move the hand, which he had been unable to do before the operation, and the following morning the movements of the arm were quite free. His facial paralysis had also disappeared. Astereognosis was noticed in the left hand. The discharge was profuse. His subsequent recovery was uneventful. On August 29 he had a severe headache and loss of motion of the left arm, which disappeared after the wound was dressed and a small collection of bloody fluid evacuated. On September 4 his condition was excellent; the wound still discharged profusely, but the muscular improvement steadily continued. He had good control over the muscles which were formerly paralyzed. Astereognosis disappearing. Babinski's reflex still present. On September 27 the movements of the parts were practically normal. The bone flap was firmly united to the skull. Only a small sinus, one inch deep, remained, which subsequently healed. His condition is now (November 12) normal, except that his left hand is not as strong as normal.

An examination of the brain tumor in the pathological laboratory showed that it was a fibroma, with appearances in parts which were somewhat suspicious of sarcoma. There were no glia cells. The question as to the nature of the cyst and the origin of the tumor is an interesting one. Judging from the speedy and com-

plete return of function, they did not result in destruction, but only in pressure and displacement of the brain.

DR. M. G. SCHLAPP, who, as neurologist, had examined both patients at the Presbyterian Hospital, said that, in the tumor case, the improvement following the operation was so marked that the question arose in his mind whether the cyst did not exist long before the tumor, possibly from some congenital cause, not, however, an embryonic diverticulum from the ventricle as may occur, because the tumor apparently grew from the wall of the cyst and was a fibroma. Hence, the cyst wall must have been of connective tissue and not lined by ependyma cells. The tumor growing from the wall of the cyst distended the cyst, not only by its own mass, but by causing the amount of fluid in the cyst to increase, which, producing pressure upon the surrounding tissue, caused a cessation of the function of the fibres mostly involved (arm), but when pressure had been relieved, the function to a great extent returned.

The location of the tumor (fibroma) was a very interesting one, being in the brain, surrounded on all sides by nervous tissue, from which a fibroma cannot develop. Hence it must have developed from the connective-tissue cyst wall, which probably took its origin from the perivascular connective tissue. Such cases are very rare. Prognosis in this case is probably good.

DR. GALLAUDET spoke of a somewhat similar case in which he had recently been called upon to operate. The patient was a man, fifty-five years old, who, eight months ago, suddenly had a generalized epileptic convulsion. Upon recovery from this he had two attacks of convulsions on the right side. Later there developed certain distinct areas of anæsthesia on the same side, especially of the face and upper extremity. Subsequently, he had two convulsions limited to the right upper extremity. Examination of the eyes was negative.

The patient was in Bellevue Hospital, under the observation of Drs. Norrie and Dana, and a probable diagnosis of tumor in or under the left Rolandic area was made. Two weeks ago, Dr. Gallaudet operated, removing a large, horseshoe flap of bone from the skull in the region indicated. When the dura was opened, the brain was apparently normal in appearance, with the exception that it was somewhat soft and collapsed, and a great deal of serum exuded. An aspirating needle was inserted in four different

places, downward, forward, and inward. The needle went in at least two inches, but nothing was discovered. On the day following the operation there was a loss of power in the right upper extremity, which still persists; it is spastic in character. The patient has also developed incontinence of urine and fæces. On the second day after the operation he had a temporary spasm of the right upper extremity and right side of the face. Re-examination by turning down the flap was negative.

ULCER OF THE STOMACH, WITH HOUR-GLASS CONTRACTION.

DR. JOSEPH A. BLAKE presented a woman, thirty-five years of age, who was admitted to Roosevelt Hospital on July 18, 1902. At the time she was nursing an infant twelve months old. Her family and previous history was negative, except that for several years she had had slight indigestion. She had not vomited until four months before admission, when vomiting commenced and was incessant; all her food, as she says, being vomited soon after eating. Vomiting persisted until her admission. She never vomited blood nor food that had been in her stomach for any length of time.

Two months before admission she began to have severe cramp-like pains in the epigastric region, accompanied with tenderness. In the four months there was a loss of twenty pounds in weight, and she became sallow. The bowels were constipated. No history of blood in the stools was obtained.

Upon admission she was emaciated, skin was dry and sallow. Her temperature was 99° F.; pulse, 92; respiration, 22.

The abdominal walls were flaccid. Two inches to the left of the median line and just below the costal arch a hard, irregular mass about two to three inches in diameter could be felt moving with the diaphragm. No dilatation of the stomach could be made out; but distending the stomach made the tumor more evident. Analysis of the gastric contents showed a marked increase in free hydrochloric acid and no organic acids.

Operation.—Nitrous oxide ether anæsthesia. Incision five inches long in linea alba above umbilicus. The stomach was found to be embedded in adhesions which bound it to the liver and pancreas, especially in the neighborhood of the cardia. Two inches from the cardia it was constricted and indurated, the con-

stricture forming an isthmus two inches long, uniting a cardiac and pyloric division of the stomach, the latter being more than double the size of the former. On account of the adhesions, their exact disposition could not be made out until a tube had been passed and the stomach inflated. It was then found that they could not be opposed unless unwarrantable force was employed.

The pyloric division was then explored through an incision in its anterior wall, the finger being passed into the constriction, which admitted it easily. The lower wall of the constriction was covered with a soft tissue feeling like granulation tissue. No indurated ulcer was felt. The constriction was stretched until it would nearly admit two fingers.

Inasmuch as it was impossible to get at the cardiac division on account of the adhesions which had obliterated the lesser peritoneal sac, and therefore bound the stomach to the pancreas, and as the two divisions could not be approximated, gastro-enterostomy by Von Hacker's method was performed with the pyloric division, by means of Murphy's buttons, with the idea of improving the ulcer. Entero-enterostomy was also done. The anterior wound was used to introduce the stomach button, only the inner cylinder being passed through a short slit in the posterior wall of the stomach. The wound in the anterior wall of the stomach was then closed.

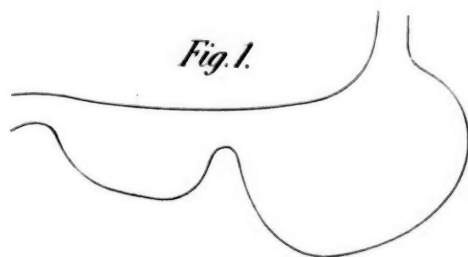
The subsequent results have been marvellous. The patient has not had a gastric symptom since the operation. She eats everything, and has gained thirty pounds in weight.

The explanation of this improvement may be that the gastro-enterostomy, by affording physiological rest and neutralizing the hyperacidity, has brought about the healing of the ulcer. The buttons have not been passed.

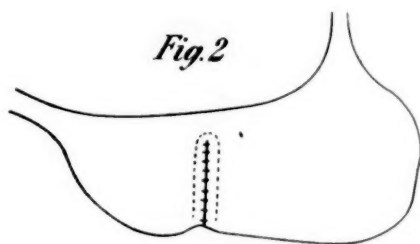
HOUR-GLASS CONTRACTION OF THE STOMACH.

DR. F. KAMMERER presented a man of forty-six years who had suffered for four years from symptoms referable to ulceration of the stomach; lately he had shown signs of pyloric obstruction. He has lost twenty pounds in weight during the last three years. On opening the abdomen under ether, a typical hour-glass contraction of the stomach presented itself. The larger part of the stomach was on the cardiac side, the capacity of this portion being about double that of the compartment on the pyloric side.

The stomach was adherent posteriorly at the point of contraction, and could not be raised from the abdominal cavity, although the dependent vertical portions could be nicely approximated. The contracted portion, it seemed, would not have admitted the index-finger. Beginning at the lowest point of the constriction, a running suture was applied through the serous and muscular coats, bringing the vertical edges of both compartments of the stomach



into close approximation along their posterior margins. An inverted U-shaped incision was now made through the entire thickness of the stomach-wall, about one-quarter of an inch to either side of the Lembert suture. The posterior wound edges were now brought together with another running suture from within; the same procedure being then applied to the anterior edges from without. The final act of the operation consisted in re-enforcing



the anterior suture with a running Lembert stitch and placing a few extra sutures at the lowest point of the stomach through the serous and muscular coats, where tension would naturally be greatest. When the stomach was first incised, a deep ulcer, just admitting the index-finger for about an inch, was discovered on the posterior wall of the stomach, immediately above the point of constriction, near the lesser curvature. This had evidently perforated all the coats of the stomach, but was enclosed within firm

adhesions. The latter had evidently prevented the delivery of the stomach upon the abdominal walls at the beginning of the operation. The patient made an uninterrupted recovery, and has gained twenty-two pounds in weight since the operation last June.

The principle of the method is practically the one demonstrated by Dr. Finney, of Baltimore, at the last meeting of the American Surgical Association.

PERFORATING TYPHOIDAL ULCERS, WITH GENERAL PERITONITIS.

DR. JOSEPH A. BLAKE presented a boy of sixteen years who was admitted to Roosevelt Hospital in the evening of August 24, 1902, unable to give a history of his illness except that he had been in bed for ten days, and that for three days he had had severe abdominal pain and vomiting. Afterwards it was found that he had been ill for ten days with the typical symptoms of a case of walking typhoid before he had taken to bed; and that three days before admission he had had a sudden attack of severe pain in the lower abdomen accompanied with swelling and tenderness.

When he entered the hospital, he was apathetic, the tongue was heavily coated. The respiration was superficial. The heart and lungs were normal. The abdomen was moderately distended; there was general rigidity and tenderness most marked in the right inguinal region. The spleen was palpable. There were no rose spots. There were no evidences of free gas or fluid. Leucocytes, 20,000; temperature, 102.2° F.; pulse, 140; respiration, 32.

With the absence of a definite history, a diagnosis of a spreading peritonitis from appendicitis or typhoid perforation was made, and operation was performed in less than an hour after admission, under general anæsthesia with nitrous oxide and ether. The incision was four inches long through the right rectus sheaths.

On opening the abdomen the peritoneal cavity was found full of pus, which extended throughout the greater cavity with the exception of the region immediately about the spleen. The pus from the right side of the abdomen and from around the liver was thick and white, while that from the left side was thinner.

The intestines were all markedly injected and distended, and those lying in the lower abdomen and pelvis were agglutinated together by a soft fibrinous exudate. The cavity of the pelvis was

full of pus and yellow fæces. The mesenteric glands were enormous and of a purple color; looking as if they were on the point of bursting.

The incision being directly over the appendix, it presented, and its extremity being embedded in a mass of lymph it was removed. The ileum was then drawn up in the wound, and three perforations were found in a segment lying between twelve and eighteen inches from the ileocolic junction. From two of these, which were each one-quarter of an inch in diameter, streams of thin yellow fæces were pouring, while the third was minute. The intestines were emptied in so far as was possible through the perforations, and they were then closed with purse-string sutures. The whole cavity was then thoroughly washed with hot saline solution, without drawing any of the intestines out of the wound except the portion containing the perforations.

The excess of saline was removed, and the wound closed with a cigarette drain one-half inch in diameter passing to the pelvis. Time consumed in operation was forty-five minutes. Shock, which was severe, the pulse being 172, was combated with an infusion of 1000 cubic centimetres of normal salt solution and with saline enemata. Six hours after the operation his temperature was 107° F.; forty-eight hours after that it was normal. After that it ran an irregular course, partly due to his typhoid and partly to a deep infection of the whole abdominal wound, which necessitated opening of both the skin and the rectus sheath. The pelvic drain was removed at the end of a week. The bowels were moved on the fourth day. The Widal reaction was positive after the operation. Convalescence after the first week was steady and uninterrupted.

PISTOL-SHOT WOUND OF THE ABDOMEN.

DR. ELLSWORTH ELIOT, JR., presented a young man, aged twenty-five years, who was admitted to Gouverneur Hospital last June, suffering from a pistol-shot wound of the abdomen. Two hours after his admission, when Dr. Eliot saw him, the patient complained of abdominal pain and tenderness. There were no evidences of shock, and his general condition was so good that it seemed as though the bullet had been deflected from its course and had traversed the circumference of the abdominal wall rather than penetrated the cavity. The point of entry of the bullet was just

below and a little to the right of the umbilicus, and an incision was made with this point as its centre. As the incision was deepened, it was found that the peritoneal cavity had been penetrated. The peritoneum was thereupon divided, and, after evacuating a small amount of blood and fæces, ten perforations of the small intestine were found in a section of the gut not more than three feet long and some twenty inches away from the ileocæcal valve. Each perforation was exposed, and closed by means of a purse-string suture; the suture was passed through the serous and muscular coats of the intestine and tightened after inverting the perforation, so that the opening was inside of the gut. In two perforations which were situated near the mesentery this procedure was not followed on account of the danger of including a large-sized vessel in the suture: they were closed, instead, by means of a double row of Lembert's sutures.

In addition to the perforations of the gut, there were two perforations of the mesentery, one involving a vessel of considerable size.

After thoroughly cleansing the abdominal cavity, the wound was closed layer by layer, with drainage. Twenty-four hours after the operation the patient passed gas per rectum, and forty-eight hours later he had a movement of the bowels. A slight, localized peritonitis developed, but otherwise the patient made an uneventful recovery, and at the end of the fifth week complete healing of the wound had taken place.

CAVERNOUS ANGIOMA OF THE NECK.

DR. ELIOT presented a man, thirty-five years of age, from whom, in 1885, a small angioma was removed from the left sub-maxillary region. The patient remained free from recurrence for five years, at the end of which time a small lump about the size of a hazel-nut appeared just above and behind the old scar; this growth remained stationary until five years ago, since which time it has grown steadily until at present it is as large as a grape-fruit.

On two occasions, the last six weeks ago, the swelling has become hard and incompressible, while the corresponding tonsillar region showed signs of acute inflammation. During these attacks the pulsation of the tumor also disappeared. After a time, with subsidence of the inflammatory symptoms, the tumor again became soft, elastic, and pulsating.

On examination, the left side of the neck is the site of a rounded, oval, colorless swelling, extending from the hyoid bone to the ear behind, and from a point two inches above the left sternoclavicular region to the zygoma above. There is a pronounced expansile pulsation and a loud bruit localized over the region of the tumor. Pressure on the artery below checks pulsation and bruit, and is accompanied by a slight diminution in the size of the tumor, which is still further decreased by pressure.

Examination of the tonsillar region shows a slight protrusion of the mucous membrane into the cavity of the pharynx. The patient's general condition is excellent.

Operation.—Gas and ether anæsthesia. An incision was made along the anterior border of the sternomastoid muscle, extending from the sternoclavicular articulation to the zygoma above, and was slightly curved over the most prominent portion of the tumor. The incision was deepened below, exposing the common carotid artery, around which a provisional ligature was thrown but not tightened. The artery was half again as large as is generally the case. The tumor was then gradually enucleated from below upward and laterally, its communications with the external jugular vein, the temporomaxillary vein and the external carotid artery being divided between two ligatures. The largest artery was about the size of a radial. After the removal of the tumor and the ligation of all bleeding points, the external carotid artery was identified in the zygomatic fossa and ligated above and below, to diminish the possibility of recurrence of the growth. The artery lay for a distance of several inches close to the deep surface of the tumor.

The wound was closed with interrupted silk sutures and a sterile dressing applied. The general condition of the patient at the end of the operation was excellent.

The patient made an uneventful recovery. The greater portion of the wound healed per primam. Near its centre a small salivary fistula persisted for several weeks and then closed. There has been no recurrence since.

The tumor removed was an angioma of the cavernous type. The largest vascular space was situated in the centre of the tumor and was about the size of a lemon. There were numerous other smaller cavities distributed through the substance of the growth.

A REVIEW OF THREE CASES OF TYPHOID PERFORATION.

DR. F. TILDEN BROWN read a paper with the above title, for which see *ANNALS OF SURGERY* for March.

DR. WOOLSEY referred to the selection of an anæsthetic in operations of this character. In two cases where he employed cocaine anæsthesia, the result was not very satisfactory, and he would not resort to this anæsthetic again in similar cases unless it was absolutely necessary. The use of ether or chloroform is preferable. The incision through the abdominal wall is easily and painlessly made under cocaine, but the resulting shock seemed much greater than when a general anæsthetic is employed. In one of the two cases where he used cocaine, a median incision was made, but, as the perforation was within two inches of the ileocæcal valve, it was necessary to retract the right edge of the wound very strongly; this gave rise to considerable pain, and seemed to increase the shock.

In all his cases, Dr. Woolsey said, the perforations were within fifteen inches of the ileocæcal valve.

DR. A. J. MCCOSH said he quite agreed with Dr. Woolsey that a general anæsthetic was preferable to a local one in these operations. The speaker said he has observed that patients suffering from typhoid fever stand both the anæsthetic and the operation very well, and that there is less shock after the use of chloroform, if the drug is judiciously administered in small quantities, than after the use of a local anæsthetic.

DR. KAMMERER said his own experience was corroborative of the statement made by Drs. Woolsey and McCosh that the shock after cocaine anæsthesia was greater than that after general anæsthesia, a point to which Henle, of Von Mikulicz's clinic, had called attention a year or so ago.

DR. BLAKE said that in all the cases of typhoidal perforation which had come under his observation, the muscular rigidity was the most constant and reliable symptom. In one case of supposed intestinal perforation where he was called upon to operate, muscular rigidity was absent, and the operation failed to reveal a perforation. He did not think that the blood-count gave us much clue as to the onset of peritonitis.

DR. HOTCHKISS said he had operated upon two cases of typhoidal perforation. In both instances the perforations were

near the ileocaecal valve, and were readily found on the anterior wall of the ileum. In both cases peritonitis had already developed, and both had ended fatally.

DR. KILIANI referred to two cases upon which he had operated last spring. In both cases the perforations were situated near the ileocaecal valve.

DR. BROWN, in closing, said that in his last case the perforation, which was firmly covered by omentum, was situated about six inches from the ileocaecal junction. In another case it was situated about fourteen inches from the ileocaecal junction. The three perforations in the other cases were not definitely located, excepting that one of them was quite near the caecum.

HÆMORRHAGE FROM THE SPLEEN IN TYPHOID FEVER.

DR. F. KAMMERER showed the specimen of the case of hæmorrhage from the spleen in a typhoid patient of the third week, to which he had referred at the last meeting of the Society in connection with Dr. Brewer's paper.

The specimen was a very large spleen, with a rent in the capsule of about eight or nine inches. The substance proper of the organ, on careful examination after extirpation, proved intact. No fissures or tears could be discovered. The hæmorrhage had evidently arisen solely from the capsular lesion. There were no other sources of hæmorrhage discoverable at the time of operation, and a careful examination of the abdominal viscera at the autopsy revealed nothing in this respect. Before the operation, it was evident that hæmorrhage was going on, although the diagnosis of intestinal perforation was made in addition. The patient had been rather restless in bed, but no trauma was noted in the history of the case which could be held responsible for the lesion in the spleen. It was not until some search had been instituted that the real seat of the injury was found. Immediately on opening the peritoneum a large quantity of liquid blood escaped. The pelvis was filled with clotted blood. The intestines were rapidly passed through the operator's fingers several times, but no perforation was found. Both flanks contained large clots, which were removed after extending the incision from the symphysis to the ensiform cartilage. On retraction of the left border of the abdominal wound the very large spleen was exposed. On its under surface a long, adherent clot was noticed, from the base

of which at several points active hæmorrhage was going on. The clot was easily removed, exposing a straight tear in the capsule, about four inches long, from which the splenic tissue protruded like a mushroom. The hæmorrhage had now become more severe. Upon slight manipulation with the spleen, to more fully expose the lesion, the capsule, evidently under great tension even now, suddenly tore for an additional five or six inches. Immediately a much larger portion of the soft, sponge-like splenic tissue protruded from the rent, the hæmorrhage meanwhile becoming alarming. As previously mentioned, the only chance for the patient's recovery seemed to lie in extirpation of the organ, which was readily accomplished. All hæmorrhage now ceased, and the patient lived for another twelve hours.

The speaker desired to report this case more fully, as an exhaustive article had lately appeared in Langenbeck's Archives from the clinic of Kehr, of gall-stone fame, by Dr. Berger, on injuries to the spleen. This author had collected 132 cases of rupture of the organ, among which there were five patients suffering from typhoid fever. He mentions isolated rupture of the capsule as a most rare occurrence, and furthermore states that "lesions exclusively of the capsule are without danger, because they do not cause hæmorrhage." As the publication mentioned bears evidence of painstaking investigation of the literature of the subject, it would be fair to conclude that fatal hæmorrhage from a capsular lesion only, in the spleen, was a very rare, but still possible, occurrence, depending, very likely, on the pathological condition and large size of the organ.

TRANSACTIONS

OF THE

CHICAGO SURGICAL SOCIETY.

Stated Meeting, November 3, 1902.

A. J. OCHSNER, M.D., in the Chair.

RECTOVESICAL ANASTOMOSIS FOR EXSTROPHY OF THE BLADDER.

DR. E. J. SENN presented a case of exstrophy of the bladder, saying that he had exhibited the patient two years ago. At that time considerable discussion arose with reference to the prognosis. He showed the patient now for the purpose of demonstrating the possibility of performing vesicorectal anastomosis successfully, and without causing infection of the kidneys. Two years ago he made an anastomosis between the bladder-wall and the rectum. Examination of the urine before the operation showed a considerable amount of albumen and granular casts. At the present time the urine shows no albumen, but a few granular casts; specific gravity, 1015; reaction, slightly alkaline.

In doing the operation, he modified somewhat the procedure described by Dr. Jacob Frank, in that he made the anastomosis in a way similar to the manner one would make a colostomy. A longitudinal incision was made at the bas-fond of the bladder; then he drew up what he supposed to be the rectum or last part of the sigmoid through the incision, then united the bowel to the bladder-wall. At the end of three days he made an incision in the bowel and sutured the mucous membrane of the bowel-wall to the mucous membrane of the bladder, in this way securing a continuous layer of mucous membrane, or, in other words, the mucous membrane of the bladder was continuous with the mucous membrane of the bowel. Careful examination of the patient at present showed the fistula had remained patent. After having made the anastomosis, he did a plastic operation. The patient

had an exceedingly long prepuce; he button-holed the prepuce, drew it over the penis, bringing the penis through the button-hole, thus securing closure of the lower portion of the bladder. He sutured the parts as well as he could, freshened the surface of the penis, and secured primary union. After having transposed the prepuce, he next attempted to close the defect. He brought down the flap from the median line and sutured it to the margin of the transposed prepuce, and did practically a Wood operation. There was too much tension, and the operation failed. He made two large triangular flaps. One flap was transposed from the right side, the other from the left side, the two flaps sutured together over the defect. As there was a somewhat limited blood supply, the apices of the flaps sloughed. While he succeeded in covering a considerable portion of the defect, the operation itself was not entirely successful. A month ago the patient returned to him for a subsequent operation, and during the last two weeks he had succeeded in closing about two inches more of the defect, so that at the present time there remains but little to close. He said he had a superabundance of tissue surrounding the defect, so that by doing a plastic operation he thought he would succeed eventually in closing the defect entirely. His object was to show the state of the mucous membrane before closing the bladder entirely. Two years ago, before operation, the mucous membrane was covered to a considerable extent by fungous granulations. Since the operation these granulations have disappeared. At the present time the urine is clear, denoting no infection whatever. In doing the second operation, the entire defect remained closed for three days, during which time the patient urinated entirely through the rectum.

He intended to exhibit the patient again, when he had succeeded in closing up the small gap which remained.

As regards the mortality, he thought this operation was preferable to the Maydl, and believed that there should be as little mortality from it as from colostomy.

DR. L. L. McARTHUR said he presented a case some years ago before the Chicago Medical Society of this nature. The bladder was covered in by flaps from the abdominal wall. The median flap had hair-follicles in it, and in that particular case the hair grew, and a phosphatic deposit occurred upon it, so as to cause trouble. He asked Dr. Senn whether any trouble had

arisen in his case from this source, to which Dr. Senn replied there had not. He also asked whether gases and faecal matter had troubled the patient by escaping through the fistulous tract.

DR. SENN said there had been a little trouble as regards faecal matter; that small particles of it came through the fistulous tract, also some gas; but when the patient took a laxative he had very little trouble, strange to say. He thought, when the entire defect was closed, the constant stream of urine would prevent the escape of any faecal matter. In this case he had expected to get infection of the kidney, but this had not occurred.

DR. JACOB FRANK thought that when the fistula now existing was closed, there would not be any trouble from faeces, because he had found in experimenting on dogs that if he took the healthy bladder of the animal and anastomosed it with the rectum, there was, first, a severe inflammation of the bladder; but when the animal recovered from the operation, the bladder contracted, and the vesical mucous membrane took on the characteristics of the mucous membrane of the rectum, showing that the bladder could accustom itself to a foreign substance, and also more or less infection. After the dogs had recovered, there was very little trouble from that source.

He did not think the method pursued by Dr. Senn was ideal. However, it was in its infancy, and he doubted whether enough of these cases presented themselves to any one surgeon to enable him to work out the problem satisfactorily. His idea would be not to transplant the skin, but he would dissect off the bladder or mucous membrane, as was done by Dr. Halstead; the bladder grows in fan-shape, and after it was dissected off and brought over the coupler, he would close the opening where the bladder was. In this way a new bladder can be made. The bladder could be dissected off all around completely, as was shown in the case of Dr. Halstead. Instead of using the Murphy button in these cases, he had used his absorbable coupler. He thought it would be much safer to anastomose the bladder to the rectum or the sigmoid, as was done by Dr. Senn; and after that had been done to dissect off the entire bladder, freshen the edges, and whip it over the coupler or the opening.

DR. EISENDRAETH asked how long the patient could hold the urine, and what effect upon the bowel movements resulted from

the presence of such a large quantity of fluid in the rectum constantly?

DR. SENN said that the urine did not pass into the rectum at the present time, owing to the defect. During the three or four days he had the entire defect closed, the bowels moved two or three times during the day. He recalled a case in which the late Professor Fenger did a Maydl operation where the patient had two bowel movements a day.

DR. A. E. HALSTEAD stated that if he had another case of exstrophy of the bladder to operate on he would resort to the same method as in the first one, namely, doing a vesicosigmoidal anastomosis with the button. He would use the Murphy button in preference to the Frank coupler. Dr. Frank had said that a new bladder could be made by dissecting the posterior bladder wall free and folding it over the coupler. By not taking the whole thickness of the bladder-wall, but by dissecting off the mucous membrane, which one could do very nicely, because it was extremely thick and vascular, and, leaving the fascia behind to keep the abdominal cavity closed, there would be comparatively little danger of infecting the peritoneum. In doing this, by using the triangular flap, one could close in the button and make a practically intact bladder, drop it back, and bring the recti muscles together. By using the skin from the penis or the foreskin, one could close the lower part of the defect. In his case the defect was closed perfectly. Although the patient died thirty hours after the operation, the bladder was found intact at the post-mortem examination. His reason for using the Murphy button in preference to the Frank coupler was that the former could be used to advantage in shortening the time of operation; one could separate the two halves of the button, but this could not be done with the coupler. This was one of the objections to the use of the coupler.

DR. FRANK desired to say a few words in reference to the question asked by Dr. Eisendrath about the retention of urine in the rectum. In his experimental work on dogs, after an anastomosis had been made, for the first few weeks the dog passed feces mixed with the urine, but after the animal accustomed himself to the new condition, he would pass urine separately; the feces became formed.

DR. SENN, in closing the discussion, said in the present case,

in attempting to dissect up the bladder, he opened into the peritoneal cavity. He closed this opening in the peritoneal cavity, and there was no infection. Dissecting up the bladder-wall he regarded as a difficult operation, because the abdominal wall was very thin in these patients, and in opening the peritoneal cavity there was considerable risk of infection. Furthermore, in doing these operations surgeons attempted to do too much. To perform an anastomosis, and then attempt to close the entire defect at one sitting, was doing too much. In doing so many operations upon the present patient, he thought he had erred in trying to do too much at any one time. In doing plastic operative work on the genito-urinary organs, one should do a little at a time. If one attempted to do too much, there was extravasation of urine, infection, loosening of the stitches, and the operation was a failure, as a rule. It was only in the later operations on this patient that he attempted to do a little at a time, and this was when he began to be successful in the work. Where he has had to operate a number of times upon one patient, he had relied on whiskey as an anæsthetic, giving from one-half ounce to an ounce of whiskey, with one-half grain of morphia, and the patient had undergone minor operations without any pain whatever.

RENAL CYSTINE CALCULUS, WITH RIGHT NEPHROLITHOTOMY, RIGHT NEPHRECTOMY, FOLLOWED
LATER WITH ANURIA, REQUIRING A LEFT
NEPHROSTOMY; RECOVERY.

DR. L. L. McARTHUR read a paper with the above title.

DR. ARTHUR DEAN BEVAN said there was one point of great clinical importance developed by this case, and one, perhaps, that had been usually overlooked, and that is the relationship between the existence of one working kidney in an individual and the occurrence of complete anuria. When anuria developed, it did so in an individual who had but one working kidney. It was certainly a great rarity to have obstruction of the two ureters occur simultaneously. In this particular case one kidney had been removed, and therefore there was but one working kidney, and obstruction of the ureter of the single working kidney would develop the symptoms described. He was inclined to believe that anuria of a single kidney, or rather the obstruction of the ureter of a single kidney, was very much more common than one was

apt to realize. He believed, as a general proportion, it occurred in all cases of renal colic. There might be exceptions to this, but he thought, if surgeons could absolutely keep track of the function of the two kidneys in cases of kidney colic, they would find that temporary anuria of one kidney was the rule. When one realized the small size of the ureter, it was not strange that a stone sufficiently large to block the ureter might escape detection. This led him to suggest the possibility that Dr. McArthur had to deal with the blocking up of the ureter by a stone, and not by the cystine crystals themselves, and that the stone was of such a small size that it escaped detection. A stone the size of a grain of wheat was large enough to block the caliber of the normal ureter, which had not been dilated by the passage of a previous calculus, and a stone of several times the size of a grain of wheat was undoubtedly frequently passed, especially by the female, without any sensation, and without attracting the attention of the individual, or without being found. Of course, the question as to the difference between a lot of cystine crystals together having produced obstruction and the obstruction produced by the mass of cystine crystals which had formed into a calculus would not be very great, yet, without much doubt, the consolidating mass of cystine forming a stone would mechanically be more liable to produce obstruction than the loose crystals. Ultzmann, in his collection of some 800 stones, had eight cases of cystine calculi among them, most of them vesical, three of which were not seen under personal observation. Henry Morris, in his collection of the cases between 1883 and 1893, in British, Continental, and American literature, found reports of 230 cases of renal calculi, of which the passage of the stones was only mentioned in seventy-seven, and of these seventy-seven, two were cystine; that is, out of 230 stones, two were known to have been cystine, showing the percentage to be about one per cent. Analyses were made of the Hunterian collection of stones, and the proportion of cystine calculi among them was found to be about 1 per cent. An analysis of the stones in the British Museum was made, and the percentage was found to be a little less than 1 per cent. But if, in one case in 100, surgeons were going to find them, Dr. McArthur thought they were of sufficient moment to pay attention to. The fact that the urine sometimes smelled very strongly of sulphuretted hydrogen should be a rather significant

one in this connection, for the probable source of the sulphuretted hydrogen was to be found in these cystine crystals. Thinking that the cystine calculus had been overlooked in the X-ray picture on the left side, every drop of urine from the time the anuria occurred until ten days had elapsed was saved and collected in glass vessels, and the bladder was washed out two or three times with a fairly wide catheter to see if any calculus, which might have occluded the ureter, would escape. But none was found. After tension had been relieved, a glass catheter was inserted, through which a stream of yellowish, sandy-looking material escaped, making one think at first of uric acid, but, on taking this material to the laboratory and having it examined, it proved to be a mass of cystine crystals, leading the essayist to think that there was simply a thick bunch of shingle-like crystals which had blocked the ureter.

DISLOCATION OF THE INDIVIDUAL CARPAL BONES.

DR. WM. HESSERT read a paper with the above title, for which see *ANNALS OF SURGERY* for March.

DR. ARTHUR DEAN BEVAN said he had made fifty or more Colles's fractures on the cadaver, and then made dissections of the injury done after the fracture was produced. This fracture was easily produced on the cadaver by overextension of the hand, although it required considerable power to do it. In the fifty or more cases of Colles's fracture which he had produced, he had never seen a single dislocation of any of the individual bones of the carpus, nor a dislocation of the wrist, that is, between the radius and ulna and the first row, or between the two rows, or between the second row and the metacarpal bones. Injuries made in this way experimentally had invariably been fractures of the radius or ruptures of the ligaments without displacement, and sometimes a fracture of both the radius and ulna at the lower end, but never a dislocation of the carpal bones themselves.

While the essayist had taken the position that these cases were more common than surgeons realized, he was rather inclined to take the old view that they were quite uncommon, judging from his experience in his experimental work, and from his own limited experience in private and hospital practice.

Another interesting point in this case was the very marked nerve injury. This, to his mind, was the important injury. This

was interesting because it was rather a paresis than a paralysis, the intercossei muscles being intact. The ulnar nerve supplies all muscles of the little finger, the interossei, the two ulnar lumbricales, and the one and a half muscles of the thumb, the adductor, and half of the short flexor. In the case presented, he thought one muscle was singled out more than any other, namely, the adductor of the thumb. This muscle was almost entirely atrophied. It felt as though there was no muscle mass in the web between the index-finger and the thumb. The muscles of the little finger had some power; the interossei were still intact, although their power was much diminished. The explanation of this was, he thought, the contusion of the ulnar nerve at the time of the original injury. He had seen these nerve contusions where, after a long period of time, the function was almost entirely restored, and believed the prognosis fairly good in this case.

INFLAMMATION AND PERFORATION OF MECKEL'S DIVERTICULUM AS A CAUSE OF SEPTIC PERITONITIS.

DR. A. E. HALSTEAD read a paper with the above title.

DR. ARTHUR DEAN BEVAN said he had had some cases in which the remains of the vitelline duct persisted and gave evidence of trouble. He had had two cases of obstruction of the bowel produced by the remains of the vitelline duct, but had never had a case of diverticulitis in his own work, unless he had one at the present time. A woman was admitted to the hospital with a suppurating fistula at the umbilicus; a large pancake-shaped abscess, about six inches in diameter, was found on opening the abdomen, into which the fistula ran. The abscess was between the parietal wall and omentum. It was filled with pus, and in the pus was a fragment of wood that seemed to be a third of the size of an ordinary tooth-pick, which was macerated. It would seem, from the location of the condition and from the foreign body found, that it was a case of abscess due to perforation of the remains of the vitelline duct from the piece of wood which eventually perforated at the umbilicus.

A professional friend of his told him that, about a year ago, he had a case of diverticulitis upon which he had operated, with the idea that it was a lesion of the appendix. The patient recovered, and in less than two weeks this same physician had had a second case of diverticulitis. He did not know whether

these cases had been reported or not. He mentioned this to show that the condition was more common than was formerly supposed. When it was realized that fully 5 per cent. of the cases of obstruction of the intestine were produced by the remains of the vitelline duct, and that cases of diverticulitis were gradually creeping into medical literature, surgeons should realize that the condition was one of very great importance; it should be looked for both from the stand-point of ileus and peritonitis.

EDITORIAL ARTICLE.

INTRAMEDIASTINAL BRONCHOTOMY AND CESOPHAGOTOMY.

At the meeting of the Society of Surgery of Paris of March 20, 1901, Ricard¹ reported an experience with a woman, thirty-nine years of age, who had worn a tracheal cannula since infancy, subsequent to a tracheotomy done on account of ulceration of the larynx that had supervened upon an attack of typhoid fever. Notwithstanding this, she was enjoying perfect health, when, during the evening of November 14, she was seized with a sudden paroxysm of suffocation owing to the intratracheal portion of the cannula having become detached and having fallen into the air-passages. After the first seizure of suffocation had passed away, she suffered little inconvenience. A radiograph showed the cannula resting at the bronchial bifurcation, its small end dipping into the right bronchus. Efforts to seize and extract the tube by forceps introduced through the tracheal opening above were fruitless, and provoked grave threats of asphyxia. M. Ricard then, on the 17th of November, resected the upper half of the sternum, uncovered the trachea near its bifurcation, and palpated it repeatedly, but could not feel the cannula either in the lower part of the trachea or at the beginning of the bronchus. Ceasing further efforts, he placed a gauze drain in the mediastinal wound and closed the superficial flap. The later course was disastrous; after two days of well-being, on the third the temperature rose to 102.5° F.; by the fourth, symptoms of gangrene of the lung had developed; on the sixth day death occurred with asphyxia after progressive dyspnea.

¹ Ricard: *Contribution à l'étude de la chirurgie du médiastin antérieure*, Bull. et Mém. de la Société de Chirurgie de Paris, 1901, t. xxvii, No. 11, p. 304.

Notwithstanding the lack of benefit resulting from this attempt, the reporter very justly says that he has thought it of advantage to communicate to his colleagues the observations which his attempt had enabled him to make, especially as he found that the technique which he had used afforded a wide and easy access to the upper part of the anterior mediastinum, which might be useful in other cases and in other conditions.

His incision started from the left sternoclavicular articulation, followed the upper border of the sternal notch, extended for about a centimetre along the right clavicle, and then descended perpendicularly parallel to the right border of the sternum and about four centimetres from it. Having reached the upper border of the third rib, it made a right angle and returned horizontally to the sternum, which it crossed to its left border. Thus he made a U-shaped incision, the convexity of which was about four centimetres to the right of the sternum, and the upper leg of which ran along the sternal notch.

This flap was dissected up so as to expose the costal cartilages and the right half of the sternum; then with a periosteal elevator the soft intercostal tissues were detached, and the cartilages were divided by a bistoury from their connection with the ribs, and by the elevator and the finger the soft tissues behind the costal cartilages and the sternum were pushed back. This dissection was accompanied with but an insignificant amount of bloody oozing.

To uncover the mediastinum, he separated the sternum from the clavicle, and divided it along its middle throughout the whole extent of the exposed part. The only delicate part of this step was the sternoclavicular disarticulation, owing to the close relations of the posterior face of this articulation with the brachiocephalic venous trunk. He made use here of a narrow cutting forceps, such as have been used for craniectomy, and with great facility gnawed away the articulation from its superficial to its deep part. The vertical section of the sternum was quickly made by a cutting bone forceps. The soft parts of the upper portion of the mediastinum were thus exposed. He was readily enabled

to detect and push back to the right the pleural cul-de-sac and the edge of the right lung without wounding them, and without producing any noticeable modification in the respiratory rhythm. The mediastinal surface of the right pleura was separated with much ease, so that the superior vena cava was brought into view and recognized by its vertical direction, its alternations of emptiness and of repletion, as well as its considerable size.

The connective tissue in this space is very loose, so that the arch of the aorta is readily enucleated, but not so easily controlled by a retractor on account of the extensive changes of position which it is constantly making. Its volume seemed to the observer to be much greater than is seen in injected cadavers, even though the injections had been made with the greatest force.

By separating the vena cava and the aorta, and rather behind the aorta, the trachea was found, recognizable to the touch by its elastic rings. The operative field is absolutely bloodless, but the operator is embarrassed by the expansile movements of the lung, and the excursions of the aorta, so that he can seize the trachea only during the retreat of that vessel. During its diastole the aorta projects into the field of work and hides the deeper plane. Nevertheless, with the greatest clearness he was able to see the whole of the superior vena cava, the mediastinal surface of the pleura, the peritracheal glands, and the trachea. As soon as the retraction of the mediastinal tissues is withdrawn, the cavity artificially created by the operator fills up spontaneously, owing to the elasticity of the contained organs. The drainage of the lower part of the wound and the suturing of the periosteocutaneous flap present no difficulties.

His observations in this operation upon a living subject suggested to Ricard the following reflections:

The resection of the upper part of the sternum and of the adjacent costal cartilages allows the upper part of the anterior mediastinum to be explored with facility. It is possible to avoid opening the pleural culs-de-sac near the median line. With care there is no serious hæmorrhage. The breach thus created does

not permit of exploration below the bronchial bifurcation on the right side. The entire left bronchus is out of the field entirely.

At this level the bifurcation of the trachea and the beginning of the right bronchus are at a depth of ten centimetres from the surface. The superior vena cava enters the pericardium, and is with difficulty pushed aside. The pulmonary veins skirt the upper border of the bronchus. The pericardial sac ascends upon the aorta, setting a definite bar to surgical intervention lower down; hence the advice to limit the sternal resection at the level of the upper border of the third rib, since the enlargement downward of the operative space is useless and dangerous.

On the other hand, the higher up one goes, the more accessible the vena cava becomes; the more the aorta deviates to the left, the easier is it to reach the trachea. Any attempt to suture the trachea in this space is not to be thought of on account of the depth and narrowness of the space, the excursions of the aorta, the alternating distention and collapse of the vena cava, the pulsations of the heart, and the pulmonary expansions which obscure the operative field and make their wounding by the needles hardly possible to avoid.

Ricard proceeds to compare his experience with that of Milton,² of Cairo, who published in *The Lancet* of January 26 last an account of a similar accident, the fall of a detached tracheal tube into the deeper air-passage, in which the effort to secure the tube through an incision in the mediastinal portion of the trachea was successful, but was followed by death on the third day thereafter from acute sepsis. Milton gained access to the mediastinum by dividing with a saw the sternum in the median line from end to end, after suitable incision of the superposed soft parts, and then drawing the two halves of the sternum apart by the traction of strong retractors. The chief hinderance to ready separation was the fibrous fasciculi on the posterior surface of

² Milton: Removal of a foreign body from the bronchus by intra-thoracic tracheotomy, *The Lancet*, January 26, 1901, Vol. clx, p. 242.

the manubrium. After these had been carefully divided by a bistoury the segments of the sternum were easily separated to a distance of four centimetres at their upper part. At first the bifurcation of the trachea could not be brought into view, but by inserting a hook into the old tracheotomy opening in the neck and strongly drawing the trachea upward, while the innominate vessels were held aside, the bifurcation was clearly visible. Milton remarks upon the absence of shock and of hæmorrhage during these manipulations, and upon the ease with which the retro-sternal vessels were protected. It was easy to avoid injuring the pleura, and there was no interference with respiration.

An incision of about two centimetres in length was then made into the anterior surface of the trachea just above the bifurcation; some ill-smelling mucopus escaped through this opening and was wiped away; by separating the edges of this cut the interior of the trachea as far as the right bronchus was seen, but the metal tube did not come into view; the little finger being introduced and carried into the right bronchus felt the tube, and guided by this a delicate forceps was introduced and made to grasp the tube; the first efforts to extract the tube were unsuccessful, owing to the impaction of the enlarged portion of the tube within the swollen mucosa of the bronchus; but in the course of the efforts to disengage it the tube became partially rotated, and was then extracted without difficulty.

An attempt to suture the trachea was made, but the result was very imperfect. A mesh of dermatol gauze was placed behind the sternum as a drain, emerging above near the ancient tracheotomy opening. The halves of the sternum came together spontaneously as soon as the retraction was suspended, and the skin wound was sutured. During the night of the day following the patient died, and autopsy revealed an acute mediastinitis and an incipient double pneumonia.

Milton perceived that his patient died from sepsis, and that this result was due to the defective drainage of the wound and

to the looseness of the mediastinal connective tissue, which favors to a marked degree infection. He says that "were he to perform the operation again, he would modify the procedure after the removal of the foreign body by making no attempt to suture the tracheal opening, and instead, having removed the greater part of the manubrium sterni, through the large opening thus afforded insert a copious gauze plug down upon the tracheal wound so as to occlude it. The halves of the sternum below the resected part he would suture together with silver wire; the skin wound above he would suture and cover with collodion and gauze."

Ricard very reasonably criticises this proposed technique of Milton by condemning the unnecessary extensive and severe procedure of bisecting the sternum and forcibly drawing asunder the halves, to be followed by the later resection of the manubrium, when, if this last procedure is done first, a wider exposure of the mediastinum is at once secured, rendering the other attack unnecessary.

These two cases illustrate well the possibilities, the difficulties, and the dangers of attacks upon the air-passages through the anterior mediastinum. In both instances a fatal result was not prevented; in the one case because the trachea was not opened and the foreign body was left *in situ*; in the second case, because the trachea was opened and the foreign body was removed. Both cases reflect great credit upon the surgical resourcefulness and operative boldness of the operators; though these particular efforts were not crowned with success as far as the saving of life is concerned, still, they cannot fail of being helpful in solving the problem of mediastinal antisepsis whereby similar attempts in the future may possibly be carried to a successful conclusion. The future successful mediastinal tracheotomy will in all probability combine the following steps: (a) The sternal resection of Ricard; (b) the exposure of the trachea by the pushing back of the pleura and the holding aside by retractors of the great

retrosternal vessels; (c) the lifting up of the trachea by traction from above through a hook inserted into the old tracheal opening in the neck; (d) the incision into the trachea just above its bifurcation; (e) the exploration of the bronchi through the wound, the detection and the removal of the foreign body; (f) the tamponade of the anterior mediastinum, with the external wound left widely open to afford unrestricted exit of wound discharges; (g) later secondary suture or healing by granulation as the case may require.

At a meeting of the Surgical Society of Paris subsequent to the one at which Ricard made his report, Quénu³ resumed the discussion of the best method of reaching the trachea and the bronchi, calling attention to the advantages presented by a choice of the posterior mediastinum as the path through which to approach them. His opinion was based upon experiments on the cadaver. Several times he had introduced a small cannula into the trachea through an incision in the neck, and had driven it down by blowing in air from above. Each time he had later found the cannula in a bronchus. He had expected, if the operation allowed of easy access to the bronchi, that the foreign body would be felt by the finger through the membranous posterior wall of the tracheobronchial tube. Such was indeed the fact, and in each instance he was able to appreciate the cylindrical projection of the cannula, and to cut directly upon it.

The technique pursued by him was as follows: If it is the right bronchus that is to be reached, the subject is placed upon its left side, the left arm hanging down; an incision five and one-half inches long, starting from the third rib and extending to about the eighth, is made along the spinal border of the scapula; two incisions at right angles to each end of this make a flap, the base of which corresponds to the middle of the vertebral

³ Quénu: *De l'extraction des corps étrangers tracheo-bronchiques par la voie médiastinale postérieure*, Bull. et Mém. de la Société de Chirurgie de Paris, 1901, t. xxvii, No. 12, p. 317.

column. The incision is deepened through the muscles, and the musculocutaneous flap is dissected up. The third, fourth, fifth, and sixth ribs are resected, making an opening three and one-half inches long by three inches wide. The mediastinal pleura is peeled away to the outside and a broad retractor applied to the lung enveloped in its pleura; at the top of the wound the cross of the azygos vein is exposed; the œsophagus is recognized, and pushed back against the vertebral column; the left index-finger, thrust inward to the extent of three inches from the level of the ribs, feels very plainly the line of tubercles formed by the posterior ends of the tracheobronchial cartilages; an enlarged gland is enucleated and pushed downward out of the way; a toothed forceps is fixed upon the left border of the right bronchus, draws it down and brings its posterior surface into view; the index-finger, guided by the forceps, feels anew the line of the cartilages, a slight depression, and the relief produced by the projecting foreign body (*e.g.*, a cannula); the membranous wall being incised, the cannula is felt for and is extracted with a suitable polypus forceps.

This way of approach presents no great difficulties; the azygos vein is the chief vessel in the way, and it is always possible to divide it between two ligatures; the tracheobronchial rings are very plainly perceived, and equally so any hard foreign body through the membranous posterior wall of the air-duct. It is true that an operation on the cadaver is quite a different thing from an operation on the living subject; the respiratory movements are a positive embarrassment, but the lung may be depressed and should be pushed back by a broad retractor.

It is evident that these views of Quénu as to the superiority of the posterior mediastinum as a pathway to the bronchi are a further development of the observations made by himself and Hartmann in 1891⁴ with regard to the possibility of exposing the

⁴Quénu et Hartmann: *Des voies de pénétration chirurgicale dans le médiastin postérieur*, Bull. et Mém. de la Société de Chirurgie de Paris, 1891, t. xvii, p. 82.

œsophagus through this same gateway. In that previous communication was made the important observation that it is much easier to enter the posterior mediastinum, and especially to isolate the œsophagus on the left side than on the right side of the vertebral column, even though the œsophagus lies on the right side of the vertebræ. This is due to the anatomical arrangement of the pleura on the two sides. The left pleura, hardly dipping down into the costo-aortic groove, is continued directly to the side of the posterior mediastinum, but the right pleura, after having covered the costal region, insinuates itself between the vertebral column and the œsophagus, passes the median line as far as to the right side of the thoracic aorta, where it forms a cul-de-sac near the left pleura; thence it returns clothing the posterior face of the œsophagus, and then goes to form the right wall of the mediastinum. It is easy to understand from this that the detachment of the left pleura would lead the operator directly to the œsophagus, while that of the right pleura would bring him behind this cul-de-sac upon the anterior face of the vertebral bodies, and still beyond to the thoracic aorta.

In the suggestion to approach the œsophagus through the posterior mediastinum, Quénu and Hartmann were preceded by Nasiloff⁵ in 1888, and were followed by Bryant⁶ in 1895. To actually make the attempt on the living subject seems to have been first ventured by Forgue,⁷ of Montpellier, in June, 1897, upon the person of a child, eight years old, in whose œsophagus a

⁵ Nasiloff: Œsophagotomia et Resectio Œsophagi endothoracica, *Vratch*, 1888, No. 25, *ANNALS OF SURGERY*, Vol. viii, p. 308.

⁶ Bryant: The Surgical Technique of Entry to the Posterior Mediastinum, *Transactions of the American Surgical Association*, 1895, Vol. xiii, p. 443.

⁷ Forgue: *De l'œsophagotomie intramediastinale pour corps étrangers de l'œsophage thoracique*, *Congrès Français de Chirurgie*, XII Session, 1898, *Revue de Chirurgie*, December, 1898, p. 1107.

large sou-piece had become impacted and retained for three months, notwithstanding intelligent efforts to extract it by instruments introduced through the mouth. A radiograph showed very clearly the sou fixed at the level of the fourth intercostal space, and well to the right of the bodies of the vertebræ. This latter revelation of the X-ray decided M. Forgue to enter the thoracic cavity on the right side of the vertebral column, contrary to the teaching of Quénu and Hartmann, recited above. The fourth, fifth, and sixth ribs were exposed and resected to the extent of five centimetres, the angle of each rib being in the centre of the resected portion. The parietal pleura was pushed back by the ends of the fingers until the right surface of the dorsal vertebræ was reached, now quite plainly, but at a depth of about eight centimetres. The thrust-in finger felt the projecting right border of the impacted coin, but it was out of the question to attempt an incision at such a depth. Continuing, an effort was then made to enucleate the œsophagus by following with the finger-tips the line of reflection of the mediastinal pleura so as to uncover the posterior face and right aspect of the œsophagus. The manœuvre succeeded only in making the œsophagus more movable anteriorly, so that it was crowded away forward with the retro-œsophageal cul-de-sac of the pleura, until it became no longer possible to feel the coin, or to find the plane of cleavage between the œsophagus and the pleura. At this point a threatened chloroform asphyxia caused a cessation of further attempts, and a copious iodoform gauze tampon was inserted; the upper part of the incision was sutured, and a double drain was put in the most dependent part of the opening. Twelve days later, the course of the wound having been aseptic, meanwhile, an attempt to extract the coin through the mouth was again made as a preliminary to a proposed effort to reach it by an anterior thoracotomy. This time the œsophageal snare caught the coin and delivered it safely!

An attempt to reach the œsophagus by the way of a posterior

thoracotomy was also made in two instances by Rehn,^{*} of Frankfurt on the Main, which he reported at the 1898 Congress of German Surgeons. His cases are interesting and instructive. The first patient, twenty-two years of age, suffered from a close stricture of the œsophagus, thirty-two centimetres from the incisor teeth. No sound could be passed. A gastrostomy had been done. It was determined to try and expose the affected portion of the œsophagus, and for this purpose a curved incision was made at the right of the vertebral column, through which about six centimetres each of the fourth, fifth, sixth, seventh, and eighth ribs were resected. The exposed pleura was quite easily pushed back, and the end of the sound previously introduced into the œsophagus was felt, but during a paroxysm of coughing the pleura was violently forced out and was torn upon the end of one of the cut ribs. Pneumothorax and collapse followed; the pleura was sutured, the wound was tamponed, and the operation suspended. Five weeks later, the pneumothorax having disappeared, the operation was resumed. This time the œsophagus was readily exposed. It was adherent to the adjacent tissues and was drawn towards the left. After it had been freed, a longitudinal incision was made into it and its lumen found, which was dilated by introducing into it a small crescent-shaped forceps. A permanent sound was introduced, the œsophagus was sutured and the wound tamponed. After the operation the pulse became progressively more rapid and feeble, and death ensued at the end of twenty-four hours.

In the second patient there was a carcinoma of the œsophagus, the secretions from which hindered stomach digestion; and it was proposed to ligate the œsophagus below the carcinoma and drain to the surface the secretions. As in the preceding case, the pleura was torn, this time on account of the extensive adhe-

^{*} Rehn: *Operationen an dem Brustabschnitt der Speiseröhre*, Verhandlungen der Deutschen Gesellschaft für Chirurgie, XXVII Kongress, 1898, Centralblatt für Chirurgie, 1898, No. 26.

sions which it had formed with the endothoracic fascia. The patient died at the end of six days from asthenia.

In November, 1898, Llobet,⁹ of Buenos Ayres, in the person of a girl of twenty years, for whom already a gastrostomy had been done on account of a stricture of the œsophagus due to the swallowing of a caustic liquid, entered the posterior mediastinum to the left of the vertebral column, after resecting about five centimetres each of the fourth to the eighth ribs. He reports that he was able to push back the pleura without wounding it and to expose the œsophagus without injuring any of the surrounding organs. Guided by an olivary bougie introduced from the mouth he was able to divide longitudinally the strictured portion of the œsophagus, and then to introduce and leave in place a tube inserted above through the nose and reaching to the stomach, through which further feeding was carried on. The patient, after doing well for three days, developed an infective pleuritis which ended fatally on the eighth day after the operation.

From this review of the published cases in which up to the year 1900 efforts had been made to reach the bronchi or the œsophagus through the mediastinal spaces, anterior or posterior, there was little to encourage its further practice. Operative procedures which may be successfully carried out upon a cadaver are attended with the greatest of difficulty and danger in the living subject. As Willard,¹⁰ who attempted bronchotomy on dogs, very pointedly remarks "the aspects of the parts during life and after death are as absolutely different as they can possibly be. A bronchus which after death is easily exposed, and which is reached with the greatest ease, I have seen five minutes previously absolutely enclosed with huge pulsating vessels of twice the size, any one of which, if punctured, would seriously com-

⁹ Llobet: *L'opération de Nassilov*, *Revue de Chirurgie*, 1900, t. xxii, p. 674.

¹⁰ Willard: *Intrathoracic Surgery; Bronchotomy through the Chest-Wall for Foreign Bodies impacted in the Bronchi*, *Transactions of the American Surgical Association*, 1891, Vol. ix, p. 345.

plicate, if not render the operation absolutely fatal. The alteration of the parts in life and in death can only be appreciated when seen."

After such a record of disaster, and in such difficult conditions, it is especially worthy of note that finally a definite cure has been achieved after a posterior mediastinal œsophagotomy. This is reported by Enderlen,¹¹ of Marburg, as having been secured in October, 1900, in the person of a man, twenty-nine years of age, in whose œsophagus, thirty-one centimetres below the teeth, an artificial denture had become impacted. An unsuccessful effort was first made to reach it through an opening into the stomach and to pull it down into the stomach. When this was found to be impracticable, the man was turned on his left side, and through a suitable incision of the soft parts from seven to ten centimetres of the fifth to the eighth ribs on the right side of the spine were excised. During the pushing back of the pleural reflection, this membrane was torn in two places and some lung collapse followed, but no threatening symptoms supervened. The œsophagus was made prominent by a bougie introduced from the mouth, and gradually it was uncovered, fixed by hooks, opened, and the denture was extracted, not without considerable bruising of the edges of the wound in the œsophagus. No sutures were placed in the œsophagus, but a copious tampon was left in, by means of which the later copious wound secretions were led to the surface. For a time feeding through the stomach fistula and by the rectum was resorted to. After six weeks feeding by the mouth was begun, but for some time there was some leakage through the wound. In the later course of the case an abscess of the liver and a subphrenic abscess developed, which were relieved by suitable incisions. He suffered much also from joint rheumatism, and the fistula in his back persisted a long time, but before the end of a year he had regained full health.

¹¹ Enderlen: *Ein Beitrag zur Chirurgie des hinteren Mediastinum*, Deutsche Zeitschrift für Chirurgie, Band lxi, S. 441.

REVIEWS OF BOOKS.

THE PRACTICE OF SURGERY: A Treatise on Surgery for the Use of Practitioners and Students. By HENRY R. WHARTON, M.D., and B. FARQUHAR CURTIS, M.D. Third Edition. Philadelphia: J. B. Lippincott Company, 1902.

It has become the fashion of late years to publish medical works on the co-operative plan. As long as publishers permitted their editors free scope in the choice of co-workers, this plan resulted in the making of books which contained the best thought and ripest experience of the day, since it is impossible for any one man to cover the vast field of general medicine or surgery. Thus the co-operative plan produced works which excelled in all branches of medical lore. Of late, however, the reviewer has noticed with regret that several very excellent works containing material of the highest order have nevertheless been marred by chapters of decided weakness. Subjects have been divided in a puerile manner, evidently with a view to interesting in the purchase of the book the largest number of medical centres. Commercially, no doubt, for the time being, that is a good policy and insures sales in localities which had otherwise been doubtfully profitable. That such a policy may be harmful to the scientific value of the work cannot be doubted. Ultimately it will certainly be detrimental to the commercial interests of the publisher, for just as soon as medical men learn that costly and bulky volumes written on the co-operative plan are no longer the product of the best authorities on individual subjects, but rather geographical mosaics, with some pieces precious and others potsherds, they will cease to invest their meagre earnings in the costlier works, and seek smaller and less pretentious volumes of a more uniform excellence.

The volume of surgery written by Drs. Wharton and Curtis, of which the third edition is now put forth, is a work of the latter class. That it has been appreciated accordingly is evident, since three editions have been called for in five years. It is needless to remark that the work has been profitable to its publishers. This fact teaches a useful lesson, showing that a knowledge of geography and the location of medical centres is not a necessity to the builder of a book for doctors. This work of Drs. Wharton and Curtis is remarkable for two things,—evenness and balance. A just appreciation of what is essential to the general practitioner and medical student has enabled the authors to condense within the scope of twelve hundred pages all the important facts in surgery, and all else that is necessary for the instruction of those for whom the work is designed. Material which is only useful to the specialist has been omitted with advantage. No attempt has been made to make this a complete treatise on the art of surgery in all its branches, and yet bring the matter within the boards of a one volume work. Such efforts have been made in the past and have always been failures, resulting in sketchiness rather than thoroughness. No such criticism can be levelled at this book; and while the authors modestly state that they cannot hope that all their critics will agree with them respecting the relative space assigned to the different topics, they will find few reviewers who will have a serious quarrel with them. If there is one thing that is evident in this volume more than anything else, it is the justness of proportion which the writers have given to their work. No better description of the book can be given than is found in the preface to the present edition. To quote the authors, their plan has been thus outlined. The information essential to the general practitioner, and which should appear in a one volume work, includes (1) a description of the various injuries and surgical diseases sufficiently full to enable the practitioner to recognize them in practical work. (2) Full directions for the treatment of such injuries and diseases as would usually

be attended by the general practitioner. (3) A sketch of the treatment of the more difficult conditions, such as would allow the practitioner to advise patients intelligently in obtaining special skilled surgical attention. (4) An outline of the accepted facts and theories of the etiology and pathology of the various surgical affections sufficient to form a foundation for the clinical picture and give directions for the treatment. The authors' statement of intention is as concise as their accuracy in carrying it out. They have done just what they set out to do, and have succeeded in producing, first, one of the best text-books for students that has been published in some time, and, second, a work which is of equal value to the busy doctor. There is one feature in the make-up of the book which the patriotic critic might object to, and that is the frequent use of illustrations from foreign authors. Medical chauvinism is to be deprecated, and we ought to be willing to appreciate good work whether in this land or on foreign shores; appreciate it, however, without appropriating it, even where, as in this volume, credit is given. It is not chauvinistic to wish that American authors would use their own material for purposes of illustration. To be sure, it costs more to make new plates, but it is worth while to bring the illustrations in a new volume of surgery up to date with the text, and a volume written by American authors ought not to be indebted to foreign works for so many wood-cuts.

ALGERNON T. BRISTOW.

MANUAL OF GYNÆCOLOGY. By HENRY T. BYFORD, M.D., Professor of Gynæcology and Clinical Gynæcology in the College of Physicians and Surgeons, Chicago, etc. Third edition, revised and enlarged. Octavo. Pp. 590, with 363 illustrations. Philadelphia: P. Blakiston's Son & Co., 1902.

The author in the third edition of this valuable manual has succeeded in producing for the general practitioner and student a concise and complete *résumé* of modern gynæcology.

The book has been arranged for ready reference, and by rearrangement of the parts, placing anatomy, physiology, gynæcological diagnosis, and the general principles of treatment in the introductory chapters, the student is led up to and given a better understanding of developmental anomalies and gynæcological pathology. The addition of marginal notes also adds to the book's usefulness in its intended field.

Exception must be taken to the author's description of the pathology of perineal lacerations, in not mentioning the injury to the levatores ani muscles and the pelvic fascia in tears of the pelvic floor, for, without a proper appreciation of the significance of the lacerations of these structures, reparative operations cannot be understood.

For the repair of complete tears, the preference is given to Tait's method, while no mention is made of Kelly's "flap" operation, which is distinctly superior to any other procedure when the sphincter has been torn.

Too much stress has been laid upon the local and medicinal treatment of gynæcological disorders, while operative intervention is placed, except in the treatment of the severer lesions and neoplasms, in a position of last resort. This is hardly consistent with the present gynæcological teaching.

The chapters on neoplasms are full and well worth careful study. Considered as a whole, the book is commendable and worthy of perusal. The illustrations are good and are of great explanatory value.

JOHN O. POLAK.

THE DEVELOPMENT OF THE HUMAN BODY. By J. PLAYFAIR McMURRICH, Professor of Anatomy in the University of Michigan. Pp. 500, with 270 illustrations. Philadelphia: P. Blakiston's Son & Co., 1902.

The book is a student's manual of embryology, in which the principles of that science are set forth in an exceedingly clear and

logical manner. Beginning with the primordial elements, the successive changes are described and illustrated until the full-grown foetus is developed. The classical embryos of Peters, Graf, Spee, and Kollmann are described in full, and the development of the special organs are taken up in detail in separate chapters.

The work is free from discussion of mooted subjects, and the practical bearing of embryology to surgery is but lightly touched upon. The author does not attempt to present anything new, but to give a concise *résumé* of the works of His, Minot, and other recent investigators. For one who wishes to gain a clear, accurate knowledge of embryology without too much expenditure of time and energy, the work will doubtless prove more satisfactory than one of the larger standard text-books.

Extensive bibliographical references follow each chapter, which adds greatly to the value of the work.

GEORGE R. WHITE.

MEDICAL AND SURGICAL REPORT OF THE PRESBYTERIAN HOSPITAL OF THE CITY OF NEW YORK. Vol. v, 1902. Edited by ANDREW J. MCCOSH, M.D., and W. GILMAN THOMPSON, M.D. Octavo. Pp. 284, illustrated. New York: Trow Directory Printing and Bookbinding Company, 1902.

As has been the case with the previous numbers of this series, the fifth volume contains much that is of interest. No attempt has been made to classify the articles presented. The various members of the attending staff have contributed,—in some instances alone, in others in a collaboration with some of their associates. As a rule, the plan has been to represent the cases and the mode of treatment as they actually occurred in the hospital service, rather than a general discussion of the subject which the case represents.

The initial article by M. Allen Starr and Andrew J. McCosh concerns the medical and the surgical history of a patient suffering from a tumor of the brain in the motor zone, which was accurately

localized, and removed by operation. The patient made a good recovery.

The same writers also report a case of tumor of the cauda equina with a successful operation for its removal.

John W. Coe and Burton B. Lee report a series of twenty-two cases of abscess of the brain. Two other contributions to the surgery of the nervous system are "A Case of Dislocation of the Spine at the Sixth Cervical Segment" and "Sarcoma of the External Popliteal Nerve and Its Removal." A case of epidemic cerebrospinal meningitis with unusual skin lesions, reported by Linsly R. Williams, represents the medical aspects of the same group of tissues.

The medical and surgical diseases of the intestinal tract are unusually well represented. Francis P. Kinnicutt, in the second article of the volume, reports five cases of round ulcer of the duodenum which have come under observation in the hospital, and in connection with their histories gives an excellent discussion of this class of cases, and appends an extensive bibliography of the subject.

"Some Unusual Cases of Irreducible Hernia," "Acute Pancreatitis, with the Report of Three Cases," "A Rare Tumor of the Jejunum with Excision and Recovery," "Volvulus following Appendicitis," "Gangrene of the Small Intestine due to Hæmatoma of the Mesentery following Contusion of the Abdomen," and "A Rare Case of Intestinal Obstruction," are titles of other papers relating to the intestinal tract contributed by Eliot, Woolsey, McCosh, Hawkes, and Thacher. Each article, though, as a rule, a short one, is of interest, and, by reason of the stress laid upon pathology and treatment, each is instructive.

Some innovations in surgical technique are described in a well illustrated article upon the catheterization of the ureters, by F. Tilden Brown, and another showing an excellent splint for the treatment of Colles's fracture in extension, by Reginald H. Jackson.

One of the most elaborate and valuable articles of the series is upon "Wandering Kidney and the Results of Operation," by Clarence A. McWilliams. More than sixty cases are reported, details of treatment are given, together with a general discussion of the subject. An excellent monograph is the result.

The department of pathology in this hospital is evidently well equipped. Many of the articles already mentioned show the results of careful work in the pathology of the cases reported; a number of smaller articles deal with hemanalysis, tumor diagnosis and allied topics; but of all the articles in the volume the one that represents the most time, study, and original research is a short tabular statement entitled "The Pathological Conditions found at One Thousand Autopsies," by John S. Thacher. The work of years is here collected, the labor involved in such a number of post-mortems is enormous, and the collecting and tabulating such a series also represents an equal amount of work. In spite of this, it is certain that here, as in other hospitals, the recognition either in the way of scientific reputation or in pecuniary reward is less than that received in any other department of the institution. Professional enthusiasm alone will explain the sacrifice of time, labor, and actual expense which have thus been contributed.

HENRY P. DE FOREST.

TRANSACTIONS OF THE SOUTHERN SURGICAL AND GYNÆCOLOGICAL ASSOCIATION. Vol. xiv. 1902.

This volume of transactions contains a large number of excellent papers. The first paper, by Joseph Price, contends that vaginal puncture or incision for puriform disease or exploratory purposes are unsurgical procedures; and the discussion of the paper shows how widely pelvic surgeons still differ in regard to this question. We regret to observe the absence of judicious middle-ground sentiment.

The paper on the treatment of pelvic and abdominal tumors

complicating pregnancy, by Rufus B. Hall, contains some excellent suggestions.

The report of a case of extra-uterine pregnancy, by H. Tuholske, is one of the most interesting and remarkable in our literature.

In a paper on the closure of the abdominal incision with reference to ventral hernia, by I. S. Stone, appears the statement that the average surgeon has from 8 to 10 per cent. of his incisions become infected. This, in our judgment, is a pretty high percentage of impeachment of the average surgeon; and in all probability the author has included inadvertently some who are not average surgeons.

Thaddeus A. Reamy reports his first abdominal section. This was done in 1864, in the house of the patient, for a large multilocular ovarian cyst. The pedicle was ligated by a heavy cord of shoemaker's linen thread. The author relates how that the hæmorrhage from the area of separated adhesions gave him a good deal of concern. His own language describes best the method adopted by this pioneer of surgery. "What could I do? The vessels were too small and too numerous to ligate, chemical styptics within the abdominal cavity were deemed quite unsafe. I had not the surgical experience nor the common sense to pack with sponges or gauze so as to successfully compress the bleeding surfaces. The weather was cold, with an abundance of clean snow on the ground. I ordered some brought in. Compressing it with my hands into firm balls, it was held against the bleeding surfaces." The patient recovered; and the operator had performed twelve more abdominal sections before he ever saw one done by another operator. In his first thirteen cases he had three deaths. In his last 300 similar cases he has had 2 per cent. mortality. Since this first operation he has made 1600 suprapubic abdominal sections.

The subject of prostatectomy is dealt with in two important papers,—one by Hugh H. Young, of Baltimore, and one by Alex-

ander H. Ferguson, of Chicago. The discussion following these papers shows a wide divergence of opinion.

The paper on penetrating wounds of the abdomen, by E. D. Fenner, involves the statistics of 152 cases operated upon at the Charity Hospital in New Orleans, and reports six new cases. All of these six cases recovered. These tables show 105 cases of gunshot wounds and stab wounds of the abdomen, with visceral injuries, operated upon with a mortality of 70 per cent. The gunshot wounds show a mortality of 73 per cent.

The operative cure of procidentia uteri is discussed by Charles P. Noble. The operation of hepato-tomy for biliary obstruction is presented by W. E. B. Davis.

John D. Murphy reports eight cases of prostatectomy, and presents the best argument for the perineal operation.

The chief defect in these transactions appears in the discussions following the papers, which would be greatly improved by a little more vigorous editing. Many of these gentlemen have evidently gotten up and said something because they were invited to do so by the Chair, and not because they felt that they had anything to say.

The whole work is a credit to the Association.

JAMES P. WARBASSE.

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